DIMENSIONS NBS

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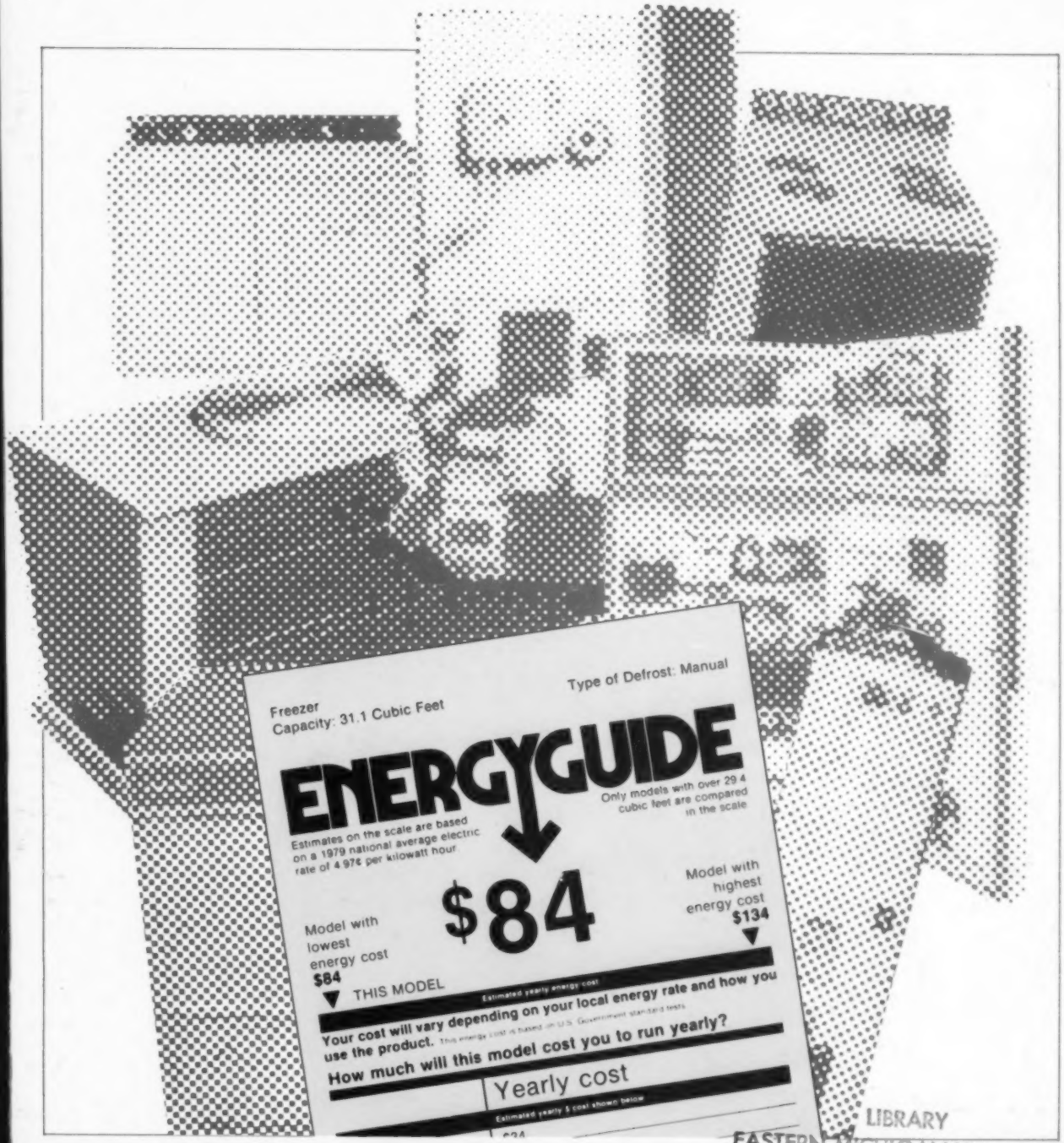

ENERGY EFFICIENCY TESTING. See page 13.

COMMENT

WEIGHTS AND MEASURES—FUTURE SHOCK

Today, the American public is encountering new uses of electronics and automation in the supermarkets, gas stations, and shopping malls. Increasing use of laser scanners (to read the Universal Product Code symbols) at the checkout counter is speeding up customer transactions, reducing the possibilities of mistakes, providing printed tapes, identifying purchases, and updating the records of the store. What we are seeing is only the "tip of the iceberg." Throughout the entire distribution system, from the farm, mine, or oil field, to the point of final retail sale, electronics and microprocessing are revolutionizing measurement procedures.

The State and local weights and measures officials still look to the Office of Weights and Measures (OWM) of the National Bureau of Standards as the major source of the measurement technology they need in their jobs. Although the former basic skills of the average inspector are still applicable, new educational programs are needed to develop a basic understanding of electronics, microprocessing, electromagnetic phenomena, statistics, and "systems." Assuming that educational programs can be developed and the new training delivered and made effective, these inspectors will also require a rather staggering set of new tools and equipment.

This reality has profound effects on the State and local weights and measures inspector. The average inspector has been on the job for many years and has spent those years dealing with direct-reading mechanical scales and measuring devices. Suddenly, this same inspector is working in a marketplace that is automated and computerized. The "specter" of the future shock is suddenly here, now.

To illustrate the needs of the future, consider the activities of an inspector who has been successfully retrained and re-equipped. The schedule for this typical day calls for the testing of a roadside truck-weighing station, inspection of electronic check-out counters at a supermarket, and investigation of a gas station suspected of overcharging. First, at the truck stop, the inspector samples a time-lapse video tape that has been monitoring the weighing operation and subsequently tests the scale itself by using a portable force-measuring device. From here, the inspector proceeds to the supermarket, attaches an electronic sensor to the store's checkout system, and tests all facets of the operation of the system, including the accuracy of the integrally installed computing scale. Next, a gasoline station is visited and all electronic, digital gasoline dispensers are tested for accuracy with a quick-connecting on-line testing device that measures the flow of any individual pump, checks quantity and price computations, and records this information as a permanent record. At all of these stops the inspector uses a radio frequency and other electromagnetic interference (RFI/EMI) signal simulator to test the sensitivities of the devices for a range of characterized interference signals.

When the inspector returns to the office, the various test devices are "plugged" into a computer, the data stored in these devices are read in, and reports are printed with test results and an analysis of the results. Additionally, selected data are stored by location of retail outlet and device for later development of monthly or annual reports, and the inspector can retrieve selected information in the event that subsequent questions are raised about a certain store, device, or product.

The basis for much of the technology suggested in these comments exists in the research centers of NBS. For example, the Center for Absolute Physical Quantities is developing the technology for a family of load cell mass comparators for use by State governments. Fluid flow measurement research in the Center for Mechanical Engineering and Process Technology offers great promise as the basis for development of testing equipment for many applications by State agencies. Much of the research in the Center for Electronics and Electrical Engineering will be transferable as usable technology to deal with RFI/EMI. These are a few samples of the continuing role NBS can play in support of State and local government measurement needs.

The partnership of the Office of Weights and Measures and the various NBS research centers needs to be strengthened so that emerging technology can be transferred at a pace that is keyed to the anticipated needs of the State and local governments. This is the challenge that OWM recognizes and intends to meet.

Albert Tholen, Chief
Office of Weights and Measures
National Bureau of Standards
A363 Physics Building
Washington, DC 20234
301/921-2401

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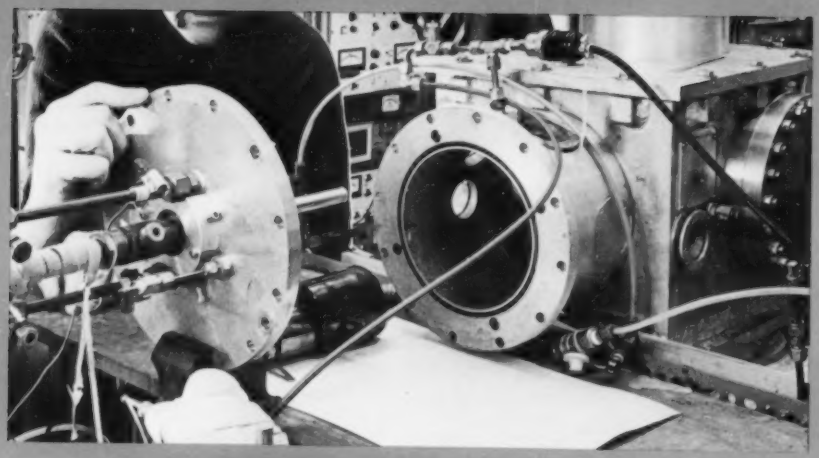
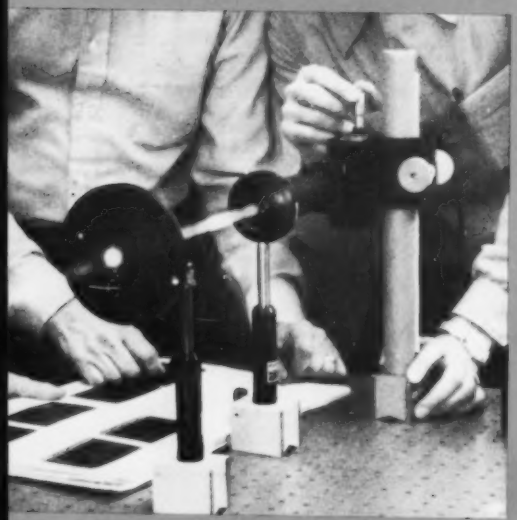


Honors for Innovation

by Michael Baum



TWELVE researchers at the National Bureau of Standards have won six awards in the 1980 round of prestigious I-R 100 Awards. Sponsored annually by *Industrial Research & Development* magazine, the awards are given to the designers of 100 inventions—selected from thousands of entries—judged to be the most significant new technical products of the preceding year. The awards were announced at ceremonies in Chicago on September 18, 1980.

Those honored this year include the following NBS scientists:

- Thomas Lucatorto, Thomas McIlrath, and James Roberts, for the development of a unique new window for use in studying vacuum ultraviolet radiation;
- William Haight and Robert Hocken, for developing a coordinate measuring system for mapping large complex-shaped objects such as airplane wings;
- Nelson Hsu, for development of a simple, convenient source of reproducible stress waves for acoustic emission experiments;
- Lanny Driver and Francis X. Ries, for an invention that brings a new level of speed, accuracy, and convenience to the measurement of radio-frequency voltages;
- David Bonnell and John Hastie, for demonstrating a new application of mass spectrometry to high-temperature vapors; and
- Robert Celotta and Daniel Pierce, for creating a new instrument for surface science—a surface magnetometer.

A Novel "Window"

Lucatorto, McIlrath, and Roberts of the NBS Center for Radiation Research contributed to optical instrumentation an innovative type of window to solve a common problem in the study of vacuum ultraviolet radiation (VUV) sources. Light in the vacuum ultraviolet range has an extremely short wavelength, from about 2000 angstroms (Å) down to 20 Å, where the x-ray spectrum begins. It is important in a number of physics and chemistry applications, including the study of plasmas. One characteristic of light in this range is that it is quickly absorbed by common gas molecules, and so it must be transmitted in a vacuum.

Spectrometers and other instruments used to measure VUV radiation must operate at a fairly high vacuum, but many of the VUV sources of interest, such as highly ionized plasmas, exist at relatively high pressures. Hence some sort of "window," transparent to the VUV radiation, is necessary to separate the two pressure zones.

Prior to this invention, there were few options. At longer ultraviolet wavelength—down to 1050 Å—lithium fluoride windows are used. Thin metal films serve as windows at shorter wavelengths, but they are fragile and can support at best only very small pressure differentials. The only other option has been to transmit the VUV light through a very fine slit, one thin enough to inhibit the gas molecules on one side from filtering through to the other. One obvious drawback is that very little light gets through.

The new window devised by Lucatorto, McIlrath, and Roberts, called a "multicapillary array" (MCA), is essentially an enlargement of the slit idea. The MCA consists of a tightly-packed bunch of thin glass capillaries, rather like a bundle of soda straws. The capillaries have very small diameters—currently from about 1.5 μm to 100 μm—and can be produced in bundles with cross sections up to 10 cm^2. They are produced commercially as a component in multichannel plate image intensifiers.

The capillary diameter is very small compared to the mean free path of the gas molecules, hence molecules that enter the high pressure end of the capillary take a long time to diffuse to the other end. A modest pumping system at the high vacuum end can compensate for this small flow and main-

Physicists (left to right) Thomas McIlrath, James Roberts, and Thomas Lucatorto demonstrate their "multicapillary array" vacuum ultraviolet window.

Baum is a writer and public information specialist in the NBS Public Information Division.

tain a high vacuum. The diameter is large, however, compared to the wavelength of the light, so a comparatively large amount of light gets through the MCA without appreciable distortion. The researchers' figures show that such arrays, properly installed, can support a pressure differential of up to 20 Torr on one side and less than 10^{-6} Torr on the other side, while transmitting 50 to 60 percent of the incident VUV radiation.

Coordinate Measuring Machine

Like the VUV window, the large-scale dimensional measuring machine developed by Haight and Hocken of the Center for Mechanical Engineering and Process Technology fills a unique niche. The system makes it possible to record, quickly and accurately, the three-dimensional coordinates of large surfaces and objects with a minimum of fuss.

The machine is built around three digital theodolites, a laser projector, and a desk-top computer. Rugged and portable, the machine can be set up virtually anywhere and, in fact, has been used inside an LNG (liquefied natural gas) cargo tank, 36 meters in diameter.

In practice, the three theodolites are set up at the points of an equilateral triangle that serves as a reference base for the measurements. The theodolites are tied to the computer, which automatically records the angular measurements of each theodolite and compares it with the other two. A helium-neon laser is used to project a cross-hair target image through a 600 mm telephoto lens onto any desired point of the structure to be measured.

Mechanical engineer William Haight (left) and physicist Robert Hocken stand amid the components of the large-scale three-dimensional measuring machine.

The target projector picks out a series of points on the structure that is being mapped, and the angular measurements of each point are determined by the three theodolites. The computer uses these angular measurements, together with the dimensions of the base triangle, to determine the three-dimensional coordinates of each target point. Since the three theodolites provide a total of six angular measurements for each point, and since only three are needed to define the position of the point, the system has a built-in redundancy check to assess its accuracy in real-time. The range of the system is from 10 m to 500 m, with an accuracy within 2 parts in 10^5, making it about 10 times more accurate than previous large-scale measuring machines. It takes about one minute to locate each target point.

Applications, according to the inventors, include measuring the size and shape of large storage tanks, aircraft wings and fuselages, ship hulls, and earth-mover blades, as well as aligning precision jigs and fixtures. The inventors also suggest that, fixed to a suitably permanent base, the system could be used to monitor deformations in structures such as large roofs or dams.

Pencil Breaking Device

Hsu's Acoustic Emission Simulator, jointly sponsored by NBS and the Lockheed Georgia Company, may be one of the most unusual calibration instruments anywhere—essentially, it is an instrumented mechanical pencil. Hsu, an engineer with the NBS Center for Mechanical Engineering and Process Technology, came up with the original idea while looking for a simple, reproducible source of stress waves to use in acoustic emission experiments.

Acoustic emission is a relatively new nondestructive testing technique in which sensitive ultrasonic transducers are attached to the structure of interest (such as a gas pipeline, bridge support, airplane frame, or pressure vessel) and used to detect the sound waves produced by local flaws in the structure—the sound produced by the growth of a crack, for instance.

Both in the laboratory and in the field, acoustic emission specialists need a test source to check the performance and level settings on their instruments, as well as to learn how particular materials or structures affect the transmission of a given waveform.

Left. Engineer Nelson Hsu demonstrates his acoustic emission simulation device.

Right. Electrical engineers Lanny Driver (left) and Francis X. Ries of the NBS Boulder Labs display the wideband radio frequency voltage comparator.

All of this requires a source of mechanical stress waves of known amplitude and shape.

One answer, Hsu found, was simply to take a mechanical pencil, run the lead out to a fixed length, and press it against a surface. Tests showed that the pencil leads almost always broke in the same clean, reproducible way.

The acoustic emission simulator for which Hsu won an I-R 100 award is a refinement of the original idea. The pencil is fitted into a jig that holds it at a constant angle, and a forcing screw is used to break the lead. A built-in load cell measures the amplitude of the pulse, which can be adjusted by changing the size and type of the lead. A peak-holding force indicator gives a direct reading of the pulse in newtons.

Voltage Comparator

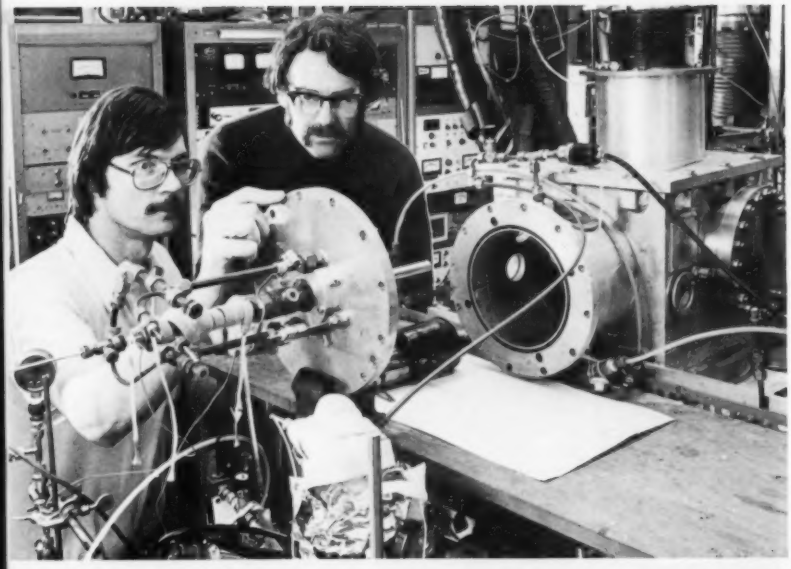
Driver and Ries of the NBS Center for Electronics and Electrical Engineering received their I-R 100 award for the development of an improved instrument for measuring the voltage of radio-frequency (rf) signals in 50 ohm coaxial systems over an exceptionally broad range of voltages and frequencies.

Previously, similar measurements had to be made by rather tedious thermal transfer techniques. The rf signal was used to raise a thermocouple or other heat-sensing device to a particular temperature and then compared with the d.c. voltage necessary to reach the same temperature. Such devices exhibit relatively slow response, require extensive corrections to measurements, and in general can only span about one octave of voltages over a narrow frequency range per instrument, requiring the laboratory to have several different instruments to cover the entire useful range of voltage and frequency.

The RF Voltage Comparator built by Driver and Ries uses an entirely different principle. A closely-matched pair of Schottky-barrier detecting diodes compares the unknown rf voltage with some reference source of a.c. voltage. The detected voltages are algebraically summed to give a d.c. voltage proportional to the difference between the two. The a.c. voltage is adjusted until this d.c. voltage is reduced to a null value, at which point the a.c. reference voltage equals the rf voltage.

The instrument has a frequency range of from less than 100 kHz to greater than 1 GHz, currently with a voltage range between 10 mV (rms) and 20 V (rms). These ranges, according to Driver and Ries, are limited primarily by the semiconductor diodes and could be increased by improvements in diode technology.

The voltage comparator can be used to calibrate a number of radio-frequency products including voltmeters, power meters, signal generators, and attenu-



Chemists David Bonnell (left) and John Hastie examine the transpiration apparatus of their transpiration mass spectrometer.

ators. In addition, it can be used as a highly precise voltmeter or as a continuous monitor of critical radio-frequency voltages whose stability might be affected by time, ambient variations, and powerline fluctuations. It is unmatched by any other precision rf voltage measurement system in terms of frequency and dynamic range and simplicity of operation.

Transpiration Mass Spectrometer

Bonnell and Hastie of the Center for Materials Science successfully combined two existing research tools to create a new analytic technique—transpiration mass spectrometry—for the study of high-temperature gases.

Bonnell and Hastie are interested in the mechanisms by which certain materials, at high temperatures and pressures, become vapors that travel as a gas to condense again elsewhere in the system. This phenomenon—vapor-phase material transport—plays an important part in many high-temperature systems. Uncontrolled, it is involved in corrosion in gas turbines, jet engines, rockets, coal gasifiers, magnetohydrodynamic channels, fossil fuel-fired boilers, and similar high temperature processes. Under controlled conditions, it finds applications in metallurgy, the production of crystals, films, and integrated circuits, and in flame inhibition and fire extinguishment, among others.

Study of vapor-phase material transport has been hampered by the high temperatures and pressures characteristic of many of the situations under investigation. The researcher who was interested in learning what mix of materials would be present in the vapor phase under a particular set of conditions was denied the use of mass spectrometry, one of the most powerful of modern analytic techniques, because mass spectrometers work only at extremely low pressures, on the order of 10^{-6} bar. A mass spectrometer can not only distinctly identify difrent types of molecules or atoms, but it can also measure the relative amounts of each species in a sample.

Bonnell and Hastie solved this problem by adapting to the mass spectrometer a technique known as transpiration, which is used to sample the vapor over a solid or liquid under controlled conditions. Basically, in a transpiration apparatus, a small sample of the material of interest is heated in a closed container to the desired temperature. The object is to sample the vapor which forms in the container, but bleeding off some of the vapor would, in itself, change the pressure inside the container and, hence, the equilibrium of the system. To avoid this, an inert "carrier gas" (such as nitrogen or argon) is passed over the sample. It collects samples of vapor molecules and carries them off. If the flow of the carrier gas into the container is properly balanced with the flow of gas out of the container, the pressure stays constant, the total extraction of sample material is small, and equilibrium is preserved.

In the transpiration mass spectrometer (TMS), a refined form of this basic apparatus is used. The test materials in the transpiration furnace are raised to the desired temperature and pressure, and a sample of the vapor is "collected" by a carrier gas. The vapor molecules then pass through an arrangement of platinum nozzles and "skimmers" (Bonnell and Hastie have more than one design) which shape a non-interacting beam of molecules that is carried to the mass spectrometer in a separate part of the apparatus. The entire transpiration part of the system is kept at a uniform temperature to prevent the vapor from condensing in the system, while separate pumping systems maintain the transpiration beam-shaping and spectrometer parts of the device at much different pressures.

A unique feature of TMS sampling is that the formation of the molecular beam is so fast that system chemistry is "frozen," and the sampled beam is truly representative of the system, including highly reactive molecules that exist only under source conditions.

The TMS system can sample gases produced in systems under controlled conditions at temperatures up to 1700 K (over 1400 °C) and pressures up to about 10 bar (a pressure approximately 10,000 times higher than previous high-temperature mass spectrometry systems). At present the TMS system is being used by NBS to investigate the durability of materials for coal utilization, the influence of reactive atmospheres on gasification plants and on the stability of glasses and slags, and details of sulfur chemistry in high temperature processes.

Surface Magnetometer

Celotta and Pierce of the NBS Center for Radiation Research won their award for the invention of an instrument that opens up a whole new area of research in surface science: a magnetometer capable of measuring the magnetization of the outer few layers of atoms on a crystal.

Surface science, which studies physical processes as they occur at just the first few layers of atoms in a material, has rapidly become an important research topic with applications to catalysis systems, corrosion research, and a variety of other economically important technologies. The magnetic properties of surface layers play roles in the design of things as diverse as magnetic information storage systems and coal gasification plants. The magnetometer developed by Celotta and Pierce is especially important because prior to this device there was no way to study the magnetization of a surface apart from the bulk of the material.

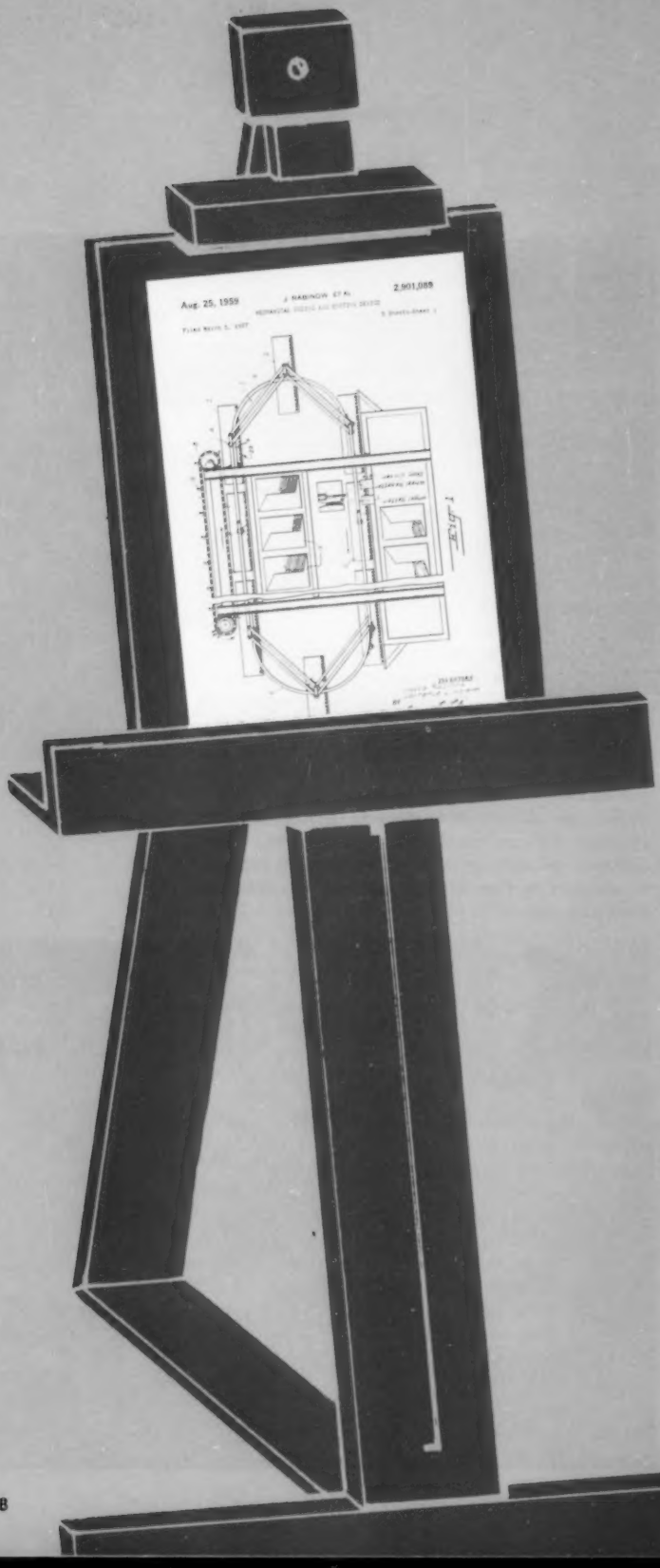
The surface magnetometer is based on a probe technique called polarized low energy electron diffraction (PLEED). Electron diffraction is a widely used tool in surface science. Beams of electrons are directed at the target surface, and from the angle and energy at which the electrons reflect from the surface, a variety of properties can be deduced. Because the low-energy beam is rapidly attenuated in the solid, only the first few atomic layers are sampled by the beam.

The magnetometer depends on a specially designed low-energy electron gun that polarizes the spin of the electrons in the beam. Electrons are said to have one of two "spins", either "up" or "down." In the surface magnetometer, the spin polarization is modulated, switching back and forth at a rapid rate. The magnetization of a ferromagnetic material is a measure of the net alignment of electron spins, so when the polarized beam strikes the target surface, the polarization of the beam will be either parallel or antiparallel to the aligned spins of the magnetized surface.

As it turns out, the intensity or efficiency with which the beam electrons rebound from the target surface depends on whether or not the probe electron and the surface electron have parallel spins. Normally, this effect is unobserved in electron diffraction because an equal number of "up"-spin and "down"-spin electrons strike the target. The modulated beam used in PLEED, however, produces an equivalent modulation in the scattered electron intensity which can be observed and measured. The strength of the modulated signal is proportional to the surface magnetization of the target.

The key device, the electron source used to produce the spin-polarized electrons, has been designed to replace a conventional electron gun in standard surface analysis systems, according to the researchers. □

Physicists Daniel Pierce (left) and Robert Celotta are shown with part of the polarized low-energy electron diffraction apparatus used in their surface magnetometer.



The Inventor as Artist

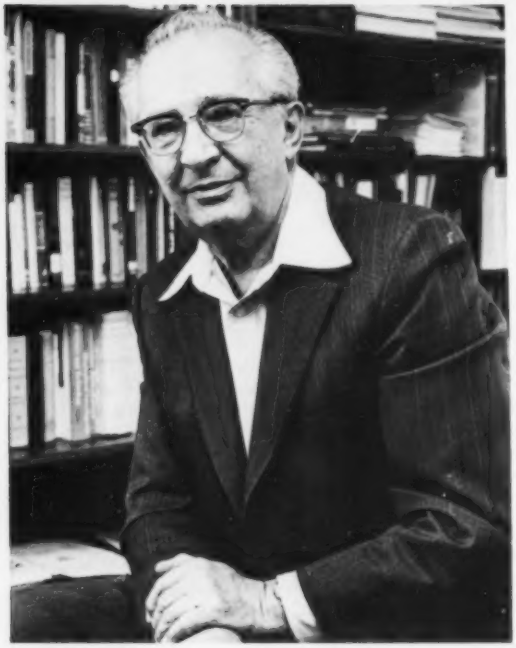
by Emily B. Rudin

JACOB Rabinow, an engineer and inventor at the National Bureau of Standards for many years and now a consultant to the Bureau's Office of Energy-Related Inventions, was selected as the 1980 Scientist of the Year by *Industrial Research & Development* Magazine. Rabinow is widely known for his 216 patents, which include the magnetic particle clutch, the automatically regulated clock, and a letter-sorting machine used by the U.S. Postal Service. Rabinow was interviewed about one of his favorite topics: the art of innovation and its relationship to the current crisis in American technology.

DIMENSIONS: In a number of recent articles, you have spoken about America's sagging economy and decline in productivity. You mentioned the need for more research and development, for creating room for "crazy ideas" and reducing the corporate "filter" which you feel discourages innovation.

Rabinow: Yes, I have here a pile of articles, all about the sagging economy. One of the problems with

Rudin is a writer and public information specialist in the NBS Public Information Division.



RABINOW–SCIENTIST OF THE YEAR

American technology is technical incompetence at the managerial level. If a manager is technically incompetent, the people under him will be. He will select the wrong people, because he doesn't know any better; and a good technical guy will not put out for a guy who doesn't appreciate it.

DIMENSIONS: It stifles productivity, really.

Rabinow: Oh, sure. The man on top has to love his work more than he loves money. He must be able to say, "This invention is beautiful; even if I don't use it, it's beautiful."

DIMENSIONS: That correlates with your statement, in an article in *Design News* (7/7/80), that art and innovation are very much the same thing.

Rabinow: Yes, innovation *is* an art. I define art as anything that affects the emotions. People say, "Engineering is not an art." And I say, "That's because you don't appreciate it." When I look at a machine and see an elegant design, not in appearance but in cleverness, I feel very excited about it. To me, therefore, it's an art form. It may not be to others. And this is, of course, true of so-called official modern art, poetry, writing, and music.

The whole concept of what is original creativity gets involved. We know very little of how the brain works. How do you recall a name? Where do you store it? The fact that you store it is without doubt. The brain is a wonderful device. And the creation of new things, I always tell people, is a matter of luck. You do not write poetry by a logical process. If you did, computers could do it, and they don't. You don't create new inventions by anything logical; you grope around and combine silly ideas, and suddenly two good ones get together, and you say, "Oops! That looks good."

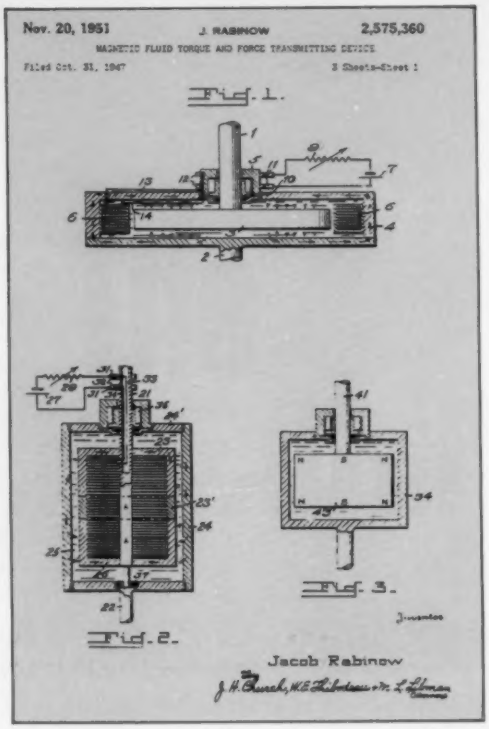
If you're very good at it, and have a lot of background, you can do this quite easily. One of the things about writing or painting or inventing is that not only must you combine many ideas in new ways, but you must also separate the bad from the good. And this is the difference with trained writers, musicians, and engineers . . . it's that we can separate, we have trained taste. We do get ideas that don't jell right, but we immediately discard them, and we have to be rather brutal, because sometimes it hurts to discard an idea that sounds good at first. However, since it's kind of a crazy, random process —a combination of ideas, with no way of knowing *a priori* whether they will be good or bad—we cannot say that we will get only good ideas. We must, because of the randomness, get a lot of ideas. There is a relationship between quality and quantity. This is true of inventions; good inventors produce a lot of inventions. We don't even know which will be the good ones until later.

DIMENSIONS: You have to turn over many stones.

Rabinow: Yes. The other thing is, we don't know what is new till after we get the idea and go to the Patent Office and discover it's not new, which is the case most of the time. And then sometimes things succeed that we didn't think would succeed, and things we thought should be successful weren't.

DIMENSIONS: That has been true in your own experience?

Rabinow: Oh, sure, this happens all the time. So the result is that we have to do a lot of it. Since


Nov. 20, 1951 J. RABINOW 2,575,360
MAGNETIC FLUID TORQUE AND FORCE TRANSMITTING DEVICE
Filed Oct. 31, 1947 3 Sheets-Sheet 1
Fig. 1.
Fig. 2.
Fig. 3.
Jacob Rabinow

the brain is such a complex thing, we don't know why we get good ideas, casually. Undoubtedly training has a lot to do with it—we don't even start with junk, because we really know it's junk. On top of the skill and training we must have the desire.

The story that necessity is the mother of invention is simply not true. It's usually the other way around. The inventor creates a new product. Nobody knows they want it. For instance, I invented the first magnetic disc file about 1948, and people said, "Who needs that much information storage?" I said, "Computers are getting bigger and faster; you can easily postulate that libraries, computers, and personnel records will need more information storage, with lots of memory." So you create the need: you create a product, and then people discover they need it. The same thing is true about reading machines. I invented one of the basic reading machines that is now in the Smithsonian. And when I did it, people said, "Why read by machine? We can read." And I said, "I know, but there's a lot of paper, and you don't need to read bank checks, credit cards, all sorts of addresses, phone books, and things you don't read for amusement. It's obvious that reading machines can do this." And people had very great doubts. Now reading machines are big business, of course.

DIMENSIONS: So innovation is not necessarily an answer to a real need, but more a perception on the part of the inventor.

Rabinow: Yes. When Bell invented the telephone, people said, "Why not use telegraphs? They are much more efficient." But the telephone created a need and today people wouldn't live without it. And so what is needed and what is required depend on society's training; we really don't know what is needed.

DIMENSIONS: Human need can be variable. It's all relative to the society we live in.

Rabinow: That's right. There's no way to say we have enough. "Enough" doesn't mean a thing.

DIMENSIONS: In various articles, you express the feeling that the limitation on innovation is set not so much by society saying, "We have enough," but more by business saying, "This is too long-term an investment for us to make a profit."

Rabinow: Oh, yes, society could always use more. The trouble with American technology is not that we have too much or not enough, because there's no way of judging that. The trouble is the "first derivative"—the rate of change. It's more important for people to have a rate of change that goes up, rather than the absolute. It's the growth; people like to feel they're moving up. And so when things start going down, they feel very unhappy. The important thing in American society right now is that we are going down.

DIMENSIONS: And on the business level, the rate of growth that you're talking about translates to short-term profits, to help corporations stay afloat.

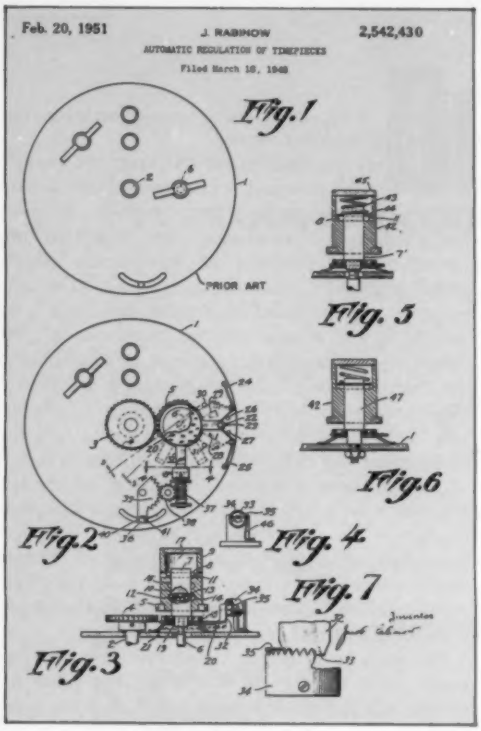
Rabinow: Yes. The trouble is that everybody is worried about the short term. But that is not fair for business or government to do. They must always balance the long term versus the short term.

DIMENSIONS: But the popular view is not the long-term one.

Rabinow: Right.

DIMENSIONS: What about the "big filter" that you claim now screens out many new ideas, based on businesses' emphasis on the short-term bottom line of profit and their reluctance to invest in research and development because these are too long-term?

Rabinow: The "big filter" is really the human race. It has to be a filter. There are lots of inventions made in all things—religion, science, economics, the arts. People come up with theories: we should raise taxes; we should lower taxes; government should regulate things; government should not set certain standards. There are many things that the average person (including me), even if technically well-trained, couldn't possibly know. For example, I have no way of knowing what's in a drug bottle.



DIMENSIONS: You want to know that it's approved, for safety. And that usually comes from government.

Rabinow: There's no other way, because some people will sell whatever makes money, and there are always charlatans who will put terrible things into drugs, air, or machinery. The human race protects itself by being conservative. And this is a good thing. The more educated people are, the more skeptical they probably are. This tends to make us delay innovation, because innovation is risky. Even if it makes sense, it's risky. After all, you don't know whether this new food that sounds good will produce birth defects.

DIMENSIONS: But as you said, there have to be a lot of "crazy ideas" floating around . . .

Rabinow: . . . To select the good. Somebody once told me that science should produce only good. But you cannot have only good. Much of our best science came out of weapon work. World Wars I and II had tremendous weapon work, which produced microwaves, TV, atomic energy, the computer art, and so on. You cannot have one without the other. So society watches this, and it's very hard to push. Thus the inventor's job is to recognize that society is conservative and doesn't want to try new things. Then we have to see a way to convince society to change over to something new. This is very difficult. Society, because of its protection against idiocy, gets conservative. They laughed at Fulton's boat, and it might have been funny for all I know. The usual reaction against a new invention is, "Who needs it? Why bother? Yeah, it's clever—so what?" Then it becomes a necessity and everybody uses it.

Now the inventor has to be ahead of society, and between the inventor and society you may strike a balance. Actually, this balance is against the inventor. For example, I invented a better phonograph, where the arm moves in a straight line. And for 14 years, I couldn't get anybody interested enough to even try it. It wasn't a question of money; I would have taken any kind of royalty. They all said, "Yes, it's correct, but nobody will know it's any better; they won't hear the difference." I said, "But I can prove that it sounds better." They said, "Yeah, you probably can, but why bother?" I finally put it on the market myself. I lost a lot of money on it, but it's now a huge success. Everybody makes my phonograph: Mitsubishi, Panasonic, Revox, Bang & Olufsen.

DIMENSIONS: Industry wouldn't touch it, apparently, until you started competing.

Rabinow: Yes, it was competing with the old stuff. And people generally don't like to throw out old stuff.

DIMENSIONS: You seem to be one inventor who has accepted the skepticism that exists.

Rabinow: Yes. I don't like it, but I understand it. You're dealing with human beings. Inventors very often have to buck this skepticism. They expect it from the average person. They don't like it from the chief engineer, and it's particularly bad when they get it from the company president, who doesn't have a technical understanding. This is very common.

DIMENSIONS: You are a modern inventor. Do you draw any parallels with some of your predecessors—da Vinci, Jefferson, Franklin, Edison, Bell? Did they work in circumstances that encouraged productivity and innovation? Or do you feel that they too came across this conservative "filter" of human society?

Rabinow: All the inventors, if you read their history, always have had this problem. Take Armstrong, for example, the inventor of FM. FM was invented much before him, but he made it practical. He committed suicide as a result of patent fights. The more radical, the newer, the more brilliant a product is, the worse the problem, because it really startles the world. A small improvement is one thing. If I said to you, "I made this machine smaller and lighter," you'd buy that; it's smaller and lighter. But if I said, "It's completely different—it does

something that these machines don't do. These are the features," I'd have to do a lot of explaining.

DIMENSIONS: And I'd have to be convinced.

Rabinow: Yes. Edison said something very interesting: that of his 1,090 patents, he never made any money on royalties, because promoting the invention and fighting in courts took more money than he made on royalties. The way he made his money was by opening and selling businesses. And that is my experience too.

So this basic skepticism is something a private inventor has to see and decide upon: whether it's worth the bother. The trouble is that big-business people today, who run on short-term profit, will say, "Nobody else does it; I don't want to do it." This happened with a headlight-dimmer which I invented. Even Rolls Royce told me, "If General Motors, Ford, and Chrysler have already said they won't use it, we won't use it."

DIMENSIONS: It seems a very non-competitive stance to take.

Rabinow: Yes, large corporations don't compete with each other. They compete on advertising but not on price.

DIMENSIONS: Or innovation?

Rabinow: That's right. They compete on what they understand, which is money.

Everybody did understand the magnetic particle clutch, which I invented. I just learned that Subaru has one in one of their fancy models. It never needs adjusting; it never wears out. I did it because somebody had invented an electrostatic clutch, which required 1,000 volts. And I said, "Gee, the magnetic clutch would be simple and clean." So we did it, and in one hour we had a clutch. The patent was so basic that it started a new subclass in the Patent Office—I have a subclass in my honor. Thousands of inventions poured in; it was obvious you could do all kinds of things with it. And the thing about the clutch that was startling is that it could have been conceived by any kid for the last 100 years. Everybody knows that iron particles stick together. The clutch has some curious electrical properties, which we analyzed. It was so obvious that it appeared, of course, in every technical magazine—because it was the kind of thing everybody understood. It was very simple.

The main thing is that I love my work and feel good about what I do. I think it has value for people, for the quality of life. This is a big satisfaction. □

PORTRAIT OF AN INVENTOR

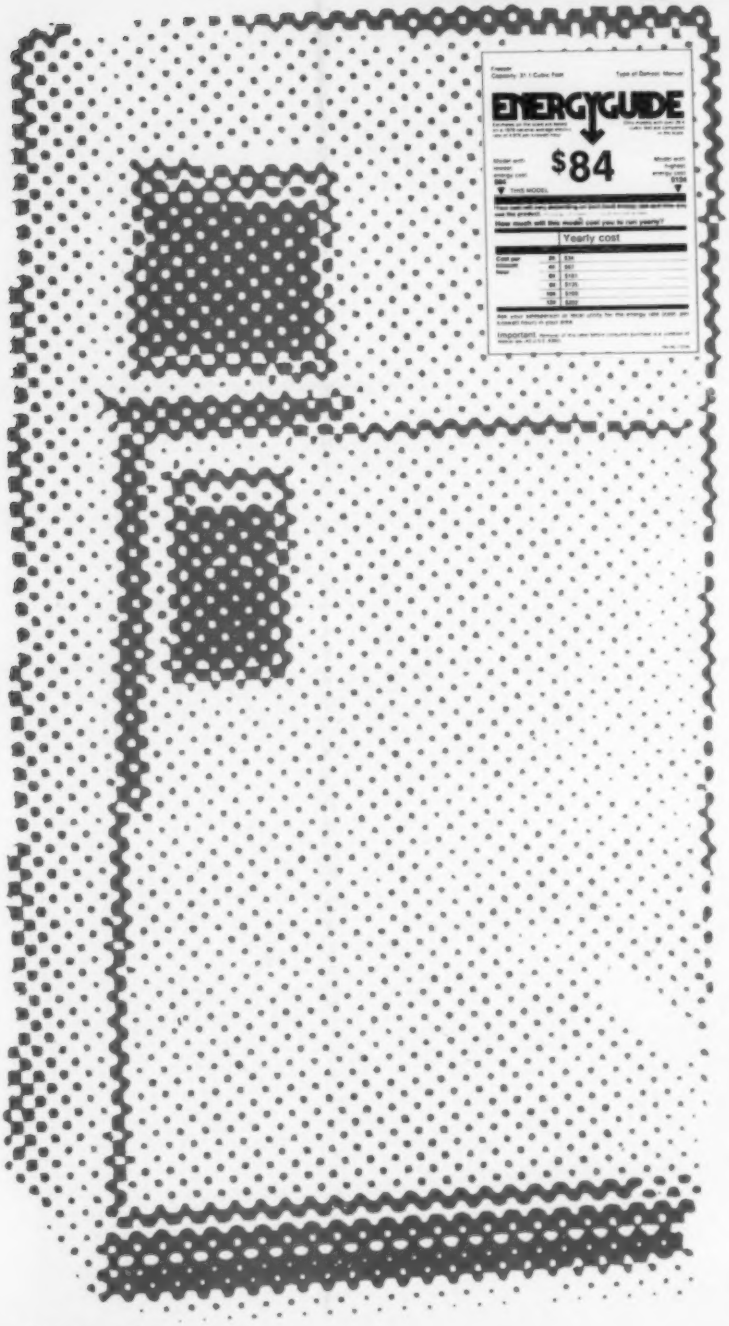
Jacob Rabinow's innovative contributions to modern American technology and his interest in "the art of invention" span a long and active career. Born in Russia, he came to the United States in 1921. He earned his bachelor's and master's degrees in electrical engineering from the City College of New York in 1933 and 1934. In 1938 he joined NBS as a junior mechanical engineer.

During World War II he was engaged in research and development of ordnance devices. He was chief of the Mechanical Ordnance Division of the NBS Diamond Ordnance Fuze Laboratory when it was transferred to the Army in 1953. He resigned in 1954 to form the Rabinow Engineering Company, which performed consulting work for many industries and for the Government. In 1964 his firm merged with the Control Data Corporation; Rabinow served as vice president of CDC from 1968 until his return to NBS in 1972.

He held three positions at NBS (1972-1975): Director of the Programmatic Center for Consumer Product Safety; Chief of the Office of Invention and Innovation; and Chief Research Engineer at the National Engineering Laboratory. He retired in 1975, but currently serves as a consultant to the Office of Energy-Related Inventions. This NBS office reviews such inventions upon request from individuals or companies and recommends promising ones to the U.S. Department of Energy for possible Federal assistance.

The author of numerous technical articles, Rabinow holds many previous honors, including the Commerce Department's Exceptional Service Award, the President's Certificate of Merit, the Naval Ordance Development Award, and the Jefferson Medal Award from the New Jersey Patent Law Association. Among his professional affiliations, he is a Fellow of the Institute of Electrical and Electronic Engineers and of the American Association for the Advancement of Science, and a member of the National Academy of Engineering.

Do Not Remove THIS LABEL



by Keming Kuo

YOU'VE probably seen that white tag attached to a piece of furniture or pillow with the ominous warning, "DO NOT REMOVE TAG UNDER PENALTY OF LAW" or words to that effect. It told you whether your cushion was stuffed with polyurethane, duck feathers, or what have you.

Now, you'll see another kind of label—this time on seven types of major home appliances—that will tell consumers the estimated yearly energy cost of the appliance—an energy efficiency rating. It, too, has a "non-removal" warning, albeit more subdued and in smaller print.

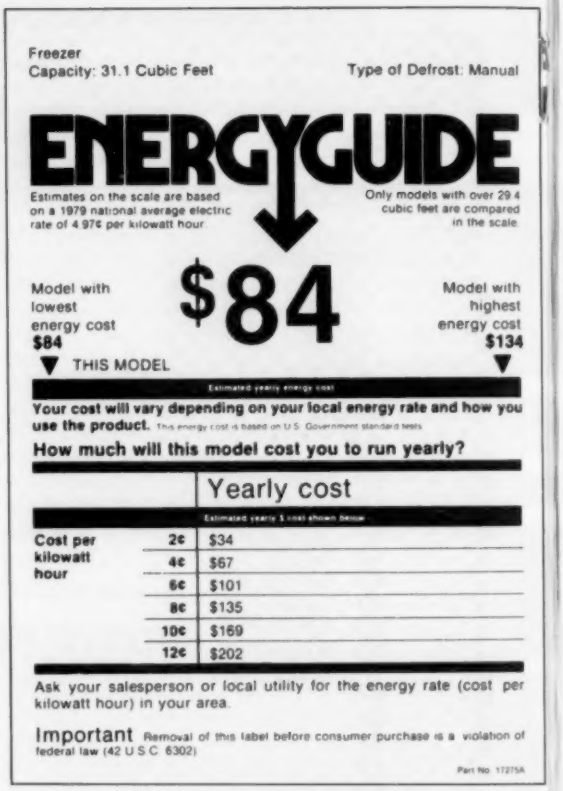
But in the tiniest print, you'll read, "This energy cost is based on U.S. Government standards tests." That's where the National Bureau of Standards is involved.

Researchers at the NBS Center for Consumer Product Technology and the Center for Building Technology have recommended the test procedures that the manufacturers use to measure the energy consumption of all their appliances. The labeling program is administered by the Federal Trade Commission (FTC), using test procedures developed by the Department of Energy (DOE)—the FTC also being responsible for enforcing the accuracy of the industry tests. Ongoing research at the Bureau is being conducted to keep up with new appliance models and refinements.

Kuo is a writer and public information specialist in the NBS Public Information Division.

DO NOT REMOVE THIS LABEL *continued*

New energy efficiency rating tags to be found on major household appliances.


Freezer
Capacity: 31.1 Cubic Feet
Type of Defrost: Manual

ENERGYGUIDE

Estimates on the scale are based on a 1979 national average electric rate of 4.97¢ per kilowatt hour.

Only models with over 29.4 cubic feet are compared in the scale.

Model with lowest energy cost
$84
THIS MODEL

$84

Model with highest energy cost
$134

Estimated yearly energy cost

Your cost will vary depending on your local energy rate and how you use the product. This energy cost is based on U.S. Government standard tests.

How much will this model cost you to run yearly?

	Yearly cost
	Estimated yearly $ cost shown below
Cost per kilowatt hour 2¢	$34
4¢	$67
6¢	$101
8¢	$135
10¢	$169
12¢	$202

Ask your salesperson or local utility for the energy rate (cost per kilowatt hour) in your area.

Important Removal of this label before consumer purchase is a violation of federal law (42 U.S.C. 6302)

Part No. 17275A

The manufacturers' data are printed on black-and-yellow labels which tell consumers how a given brand of appliance rates against similar-sized appliances of other brands. Each appliance is divided into various classes according to its fuel use, size, capacity, or other performance-related features. For example, refrigerator-freezers will be divided into groups according to their capacity in cubic feet.

The labels have been placed on products manufactured on or after May 19, 1980, and the labels are now showing up on nearly every model on the showroom floor. The seven appliances which carry the so-called "Energy Guide" label—dishwashers, water heaters, furnaces, room air-conditioners, refrigerators, refrigerator-freezers, clothes washers—account for nearly 80 percent of most homeowners' energy bills. They also have the greatest differences in energy costs among makes and models. Labels for central air conditioners and heat pumps have been proposed.

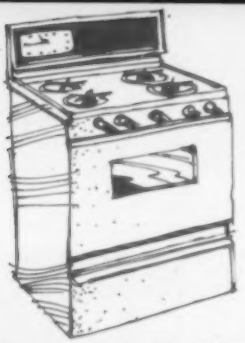
While the labeling program will give customers estimated yearly energy costs for most appliances, furnaces will be assigned energy efficiency ratings instead, since actual consumption depends so much on climate, geography, and personal preferences. Room air conditioners will carry both types of information.

The labeling program is half of the Government's appliance energy program. The second part is a set of energy efficiency standards which have been proposed for eight major home appliances—refrigerators and refrigerator-freezers, freezers, clothes dryers, kitchen ranges and ovens, water heaters, room air conditioners, central air conditioners, and furnaces.

The NBS recommended test procedures are also being used as the basis for the energy efficiency standards program, which sets a minimum energy efficiency level that must be met by each appliance. The suggested NBS test procedures are submitted to the Department of Energy for its approval and amended after the agency receives public comments. The standards are scheduled to be published within the next few months and phased in during a 5-year period; products made after July 15, 1981, will be required to meet intermediate efficiency levels, while those manufactured after January 1, 1986, will have to meet higher, proposed efficiency levels. The new energy efficiency standards will replace the original, voluntary efficiency targets which were established several years ago.

The labeling and efficiency standards programs will not only help consumers select more energy efficient appliances; they will encourage manufacturers to produce appliances that consume less energy.

Directing the energy efficiency research at the NBS Center for Consumer Product Technology is Dr. Andrew J. Fowell, chief of the Product Performance Engineering Division. Fowell and his staff of some 20 researchers work amid what appears to be a series of appliance showrooms with batteries of electronic monitors nearby. *DIMENSIONS* asked Dr. Fowell for further details about the appliance



efficiency program and the Bureau's efforts in this field.

DIMENSIONS: Dr. Fowell, how did NBS first get involved in the labeling and efficiency standards area?

Fowell: As part of the Commerce Department, NBS has been involved with the labeling and efficiency programs since their beginning as voluntary efforts—labeling in 1973 and efficiency improvement in 1975. Congress made appliance labeling mandatory in 1975 and in 1978 called for Federal standards for energy efficiency. NBS has assisted in both the voluntary and mandatory programs, in each case drafting the initial test methods to be used to measure energy efficiency.

DIMENSIONS: Who has the final say on how the standards are worded?

Fowell: Although NBS has been recommending the test methods and assessing the energy efficiency of new appliances, the Department of Energy has ultimate responsibility for the final wording of the standards.

DIMENSIONS: Have appliance manufacturers been able to follow the Bureau's test procedures?

Fowell: We're working closely with industry to make sure that when manufacturers, or the test laboratories they use, do a test, and we at the Bureau do a test, our answers are similar. We've had some problems in the area in the past, so we are doing our best to find the reason for the different measurements.

DIMENSIONS: How will consumers be sure that the labels accurately reflect the appliances' energy usage?

Fowell: The FTC is responsible for enforcing the labeling program and will send inspectors to get random samples of appliances for submission to an independent testing agency for checking. The energy efficiency standards program will be checked by DOE audits of testing records and random testing of up to 20 percent of all basic models of covered products produced each year.

DIMENSIONS: Canada started an appliance energy labeling program for refrigerators and freezers several years ago. How successful has it been?

Fowell: Their program is somewhat different from ours because the manufacturer submits an appliance to the (Canadian) government testing agency. An official with the Consumers Standards Directorate told me the program is considered a success there. The program did prompt additional research and development by the appliance manufacturers to make more energy efficient products. When one company found its competitor was making a machine that was twice as energy efficient, the company frantically tried to make some changes to make its machine more efficient.

I think the program will encourage manufacturers

Technician Irvin Philmon weighs test cloths used in performing energy efficiency tests for clothes dryers.

Andrew J. Fowell, chief of the NBS Product Performance Engineering Division, discusses appliance efficiency test results with engineer James E. Harris. Different sizes and types of metal blocks are placed on the oven-top burners of the new induction cook-top.

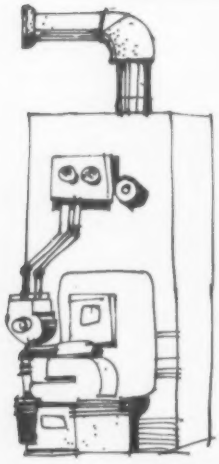
in this country to make more efficient products as well. Some manufacturers have complained about the added costs associated with the efficiency programs and say that the cost of appliances will rise. Indeed, for some appliances, the testing needed is substantial. But, in the long run, the consumer will save money because of the energy savings, even though the first cost, for purchasing the appliance, may be higher.

DIMENSIONS: What about appliances not made in the United States?

Fowell: Appliances made abroad will also fall under the labeling and efficiency standards programs. But actually, very few appliances sold here are made in other countries.

DIMENSIONS: Based on the Bureau's work in this area, have you come to some general conclusions regarding appliance energy consumption? Which appliances use the most energy? Is there much difference between different makes of appliances? What about geographical variations?

Fowell: On a national average, refrigerators are close behind furnaces, water heaters, and central air conditioners in the amount of energy consumed among the different major appliances. The energy consumption of refrigerators and water heaters varies considerably—a refrigerator with a 23 cubic-foot capacity could use between $68 and $130 of energy a year. Clothes dryers, humidifiers, and kitchen ranges/ovens are not included in the labeling program because there is little difference in energy consumption among different makes and models, and they do not represent a significant portion of the homeowner's energy use.



In the northern states, of course, the furnace consumes the most energy. Information will be available to consumers regarding variations around the country—so someone buying an air conditioner in Minnesota might decide to select a model solely for its lower cost without regard for its efficiency, while say, a Mississippi shopper might well give more consideration to the model's energy efficiency since the unit would be used much more during the year.

DIMENSIONS: Aside from an estimated annual operating cost or energy efficiency rating and an indication of how a particular appliance compares with a range of others on the market, what additional information is on the label?

Fowell: Additional information on the label will include a map of the United States and the normal number of operating hours for a room air conditioner in various parts of the country. Furnace labels will have limited energy conservation information and will ask consumers to seek more detailed information from the furnace dealer and building contractors.

DIMENSIONS: Why shouldn't appliances—like hair dryers and waffle irons—have labels?

Fowell: Actually they're not big energy users because their use is limited. In most instances, the small appliances use less than 150 kilowatt hours a year—the level set for labeling and minimum standards.

DIMENSIONS: Are payback periods—the length of time necessary to recover the original cost of the investment—considered in the labeling and efficiency standards program?

Fowell: To some extent, especially considering the amount of use an appliance gets. Clothes washer labels will show the difference in estimated energy consumption for two, four, six—and so on—loads of laundry a week. So somebody with a heavy clothes washer load will judge the payback period differently than does someone who uses a washer less frequently.

DIMENSIONS: The manner in which an appliance is used, besides its frequency, also must have an effect on energy efficiency.

Fowell: Yes, for some appliances, we determined what were "typical" use patterns. Usage data was gathered for ranges, freezers, refrigerators, and air conditioners from test units in consumers' homes. That information was used to support data we gathered from other sources. You may recall the widely publicized testing of homemakers' use of kitchen ranges conducted here at the Bureau several years ago. Researchers found consumers could achieve significant energy savings in the kitchen if they learned to use their ranges more efficiently, such as matching pots and pans to the appropriate size of range burners. So the consumer's habits have a lot to do with the final determination of how efficient an appliance is in the home. Also, there are things that consumers can do to improve efficiency even beyond more sensible use. For instance, consumers need to think about upgrading appliances. Adding insulation to a water heater is an example. Maintaining appliances regularly (such as cleaning filters and lubricating as instructed by manufacturers) will also increase energy efficiency.

DIMENSIONS: Does using an appliance for a period of time affect its energy efficiency? Also, what about new improvements to appliances?

Fowell: The original research and work on drafting test methods were done for new appliances, but we wanted to know what effects use of the appliance would have and how it might affect energy efficiency. For water heaters, we thought silting in the heater might cause inefficient operation, but we were surprised how little this reduced energy efficiency. For clothes dryers, we found that they maintain their efficiency quite well until the filter or the exhaust pipe gets clogged.

New features added to appliances—such as defrost-on-demand refrigerators — and design changes (upgrading and downgrading) must be considered. For instance, the older test method for refrigerators doesn't involve opening the door, and wouldn't cycle that refrigerator into its defrost mode, so a new test procedure was developed to account for this. The Bureau has developed test procedures for "part-load" performance that permits a more realistic estimate of the annual cost of using the appliance by taking into account the energy performance effects of constant on-off cycling. Some refrigerators also have energy-saving switches that need to be tested in both modes.

Fowell points to a thermal vent damper and discusses testing procedures with engineer Esher R. Kweller. In the foreground, engineer William F. Mullis monitors gas flow data.

Appliances used to heat food may require a variety of testing methods. For conventional ovens, the test method calls for an aluminum block to be placed on a burner to absorb heat. The block is then measured. But for microwave ovens, containers of water were used instead—because metals cannot be used in these ovens. For the new induction model ranges, which electromagnetically excite and heat metal pans and pots but do not heat any surface burner, we had to develop a new calculation technique. Now another type uses a combination of microwave and conventional heating devices—and that too requires a different testing method. It is this type of product change that NBS will have to take into account in the future. □

ON LINE WITH INDUSTRY

MAINTENANCE, TRANSFER, REPLACEMENT, OR WITHDRAWAL OF 80 VOLUNTARY PRODUCT STANDARDS

In action designed to encourage the development of product standards by private standards-writing organizations, the National Bureau of Standards has withdrawn 29 Government-sponsored Voluntary Product Standards (VPS).

Proposed withdrawal of 80 standards was announced in a June 19, 1980, *Federal Register* notice. A separate notice in the same issue detailed the revised procedures for the development of voluntary product standards, under which interested parties might submit a request to the Director of the National Bureau of Standards to retain certain standards. The procedural changes were proposed last year (*Federal Register*, July 26, 1979) and have been revised in accord with public comment.

Based on proposals from the proponent organizations identified after the following titles, the following product standards will continue to be sponsored by the Department:

PS 1-74, Construction and Industrial Plywood; American Plywood Association

PS20-70, American Softwood Lumber Standards; American Lumber Standards Committee

PS-56-73, Structural Glued Laminated Timber; American Institute of Timber Construction

PS 73-77, Carbonated Soft Drink Bottles; Glass Packaging Institute

Based on documented activity within a private standards-writing organization, the standards shown in the table will be retained by NBS for stated periods of time to permit the orderly transfer of sponsorship of such standards from the Department to various organizations.

The new arrangements follow from a Commerce Department decision that NBS will not receive direct appropriations for administering the VPS program. Instead, the Bureau's services supporting VPS development and maintenance will be available on a cost reimbursable basis to the private sector to help ensure that needed standards are developed. An Office of Management and Budget policy statement (OMB Circular A-119, "Federal Participation in the Development and Use of Voluntary Standards," January 17, 1980) sets forth the rationale on which the new system is based.

As issued by Jordan J. Baruch, Assistant Secretary of Commerce for Productivity, Technology and Innovation, the requirements for Commerce Department VPS sponsorship call for determinations that:

(1) The proposed standard is likely to have substantial public impact;

(2) The proposed standard reflects the broad interest of an industry group or an organization concerned with the manufacture, production, packaging, distribution, testing, consumption, or use of the product, or the interest of a Federal or State agency;

(3) The proposed standard would not substantially duplicate a standard developed or published by a private standards-writing organization;

(4) Lack of government sponsorship would result in significant public disadvantage;

(5) The proposed standard is not appropriate for development and maintenance by a private standards-writing organization; and

(6) The proposed standard will be funded by a proponent organization or government agency to cover costs of administrative and technical support services provided by the Commerce Department.

Further information may be obtained from James E. French, NBS Office of Engineering Standards Washington, DC 20234; telephone 301/921-3272.

Table—*Standards Retained for Stated Period*

Ident. No.	Stated Period (months)	Ident. No.	Stated Period (months)
PS 13-69	24	PS 62-74	12
PS 15-69	12	PS 63-75	24
PS 17-69	12	PS 64-75	18
PS 23-70	12	PS 65-75	18
PS 24-70	12	PS 66-75	until sponsored
PS 25-70	12	PS 67-76	36
PS 27-70	6	PS 68-76	36
PS 29-70	12	PS 69-76	36
PS 30-70	18	PS 70-76	36
PS 31-70	12	PS 71-76	36
PS 34-70	12	PS 72-76	until sponsored
PS 36-70	24	CS 98-62	18
PS 42-70	24	CS 130-60	18
PS 45-71	24	CS 138-55	12
PS 46-71	18	CS 151-50	24
PS 51-71	24	CS 192-53	12
PS 52-71	12	CS 201-55	12
PS 53-72	12	CS 227-59	12
PS 54-72	24	CS 245-62	12
PS 57-73	6	CS 257-63	12
PS 58-73	6	CS 268-65	12
PS 59-73	6	CS 274-66	12
PS 60-73	6	R 2-62	12
		R 192-63	18

NBS ANNOUNCES I/O INTERFACE VERIFICATION GUIDANCE

The National Bureau of Standards published the first notice providing technical guidance on verification of computer equipment to meet four Federal Input/Output (I/O) interface standards. In question-and-answer format, the *Federal Register* notice of August 13, 1980, explains technical implementation approaches that will lead to verification of equipment meeting standards described in Federal Information Processing Standard Publications (FIPS PUBS) 60, 61, 62, and 63.

The standards are entitled: FIPS PUB 60, *I/0 Channel Interface Standard;* FIPS PUB 61, *Channel Level Power Control Interface;* FIPS PUB 62, *Operational Specifications For Magnetic Tape Subsystems;* and FIPS PUB 63, *Operational Specifications for Rotating Mass Storage Subsystems.* FIPS PUB 60 defines the functional,

Figure 1—*Input/Output Interface—Multiple Configurations.*

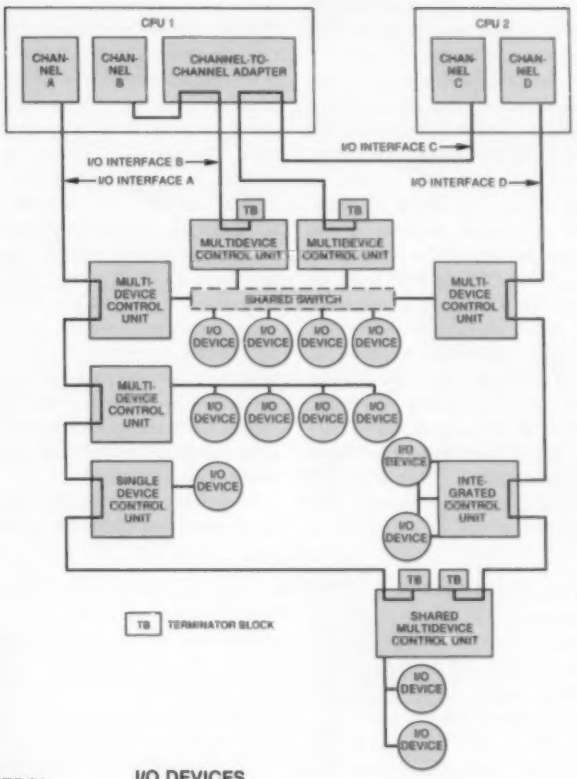
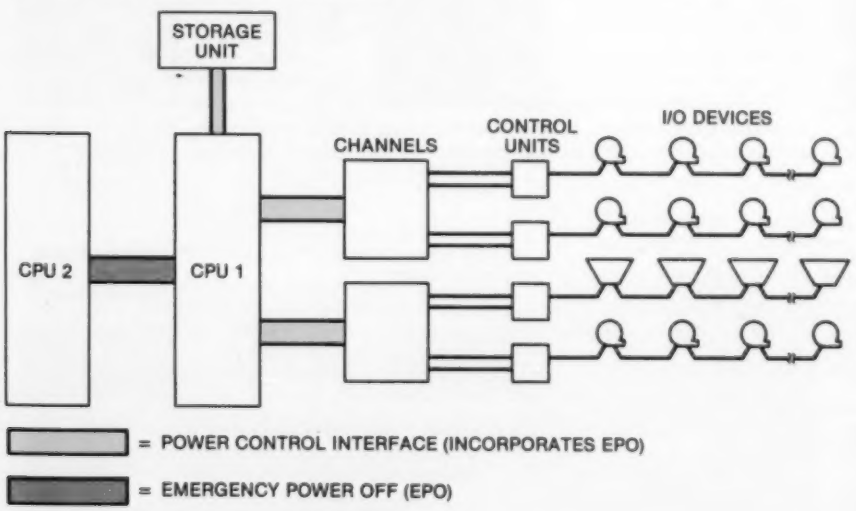


Figure 2—*Power control interface—system application.*



Note: These drawings represent typical implementations and are provided for reference purposes only. They are not intended to specify the implementation detail for the optional features shown.

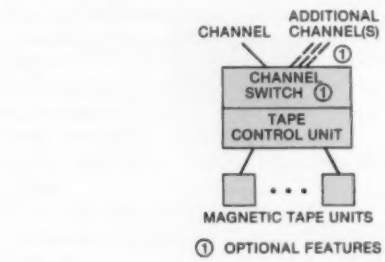
electrical, and mechanical interface specifications for connecting computer peripheral equipment as part of automatic data processing systems, shown in figure 1. FIPS PUB 61 defines the functional, electrical, and mechanical interface specifications for a power control interface for use in connecting computer peripheral equipment as part of automatic data processing systems (see figure 2). Both of these standards are applicable in defining the hardware characteristics of the I/0 channel level interface, and FIPS PUB 61 must be used whenever FIPS PUB 60 is required. They adopt ANSI document X3T9/600, Revision 2, and X3T9/666, Revision 2. FIPS PUB 62 defines the operational specifications for connecting magnetic tape equipment as part of automatic data processing systems. See figure 3 for some typical implementations. This standard applies to acquisition of magnetic tape equipment whenever use of FIPS PUB 60 and 61 are required and adapts ANSI document X3T9/780, Revision 3. FIPS PUB 63 defines the operational specifications for connecting rotating mass storage (RMS) equipment as part of automatic data processing systems. See figure 4 for an example of an RMS subsystem configuration. This standard applies to acquisition of RMS equipment whenever use of FIPS PUB 60 and 61 are required and adopts ANSI document X369/848, Revision 2.

These standards, which became effective June 23, 1980, must be cited in all Federal solicitations for medium and large-scale computer systems. Equipment must be verified by NBS to be in conformance prior to its acceptance for use by Federal agencies. For large Federal ADP procurements, such acceptance typically does not occur until 18 months or more after issuance of solicitations.

Manufacturers who are able to deliver equipment that conforms to the standards in time for acceptance and who can meet individual agency benchmarking requirements may respond to Federal solicitations for medium and large scale computer systems.

Suppliers who wish to have equipment verified are invited to submit documentation for the equipment interface to NBS. A check-list provided by NBS must be completed and submitted with the documentation. Equipment that NBS verifies as conforming with the standards will be placed on a verification list that is developed and maintained by the Bureau. Federal agencies will then be permitted to accept such equipment on orders resulting from procurement solicitations.

Requests for equipment verification or for further information may be directed to Dr. John P. Riganati, Chief, System Components Division, National Bureau of Standards, Washington, DC 20234, or 301/921-2705.



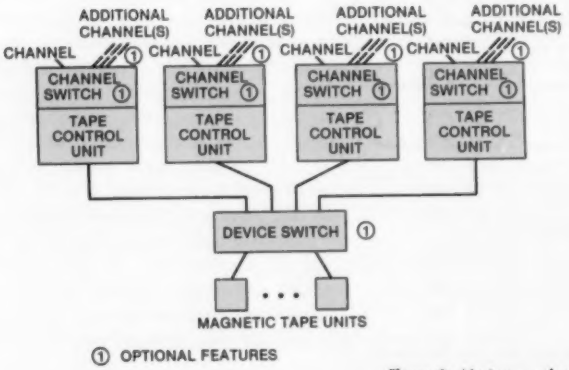
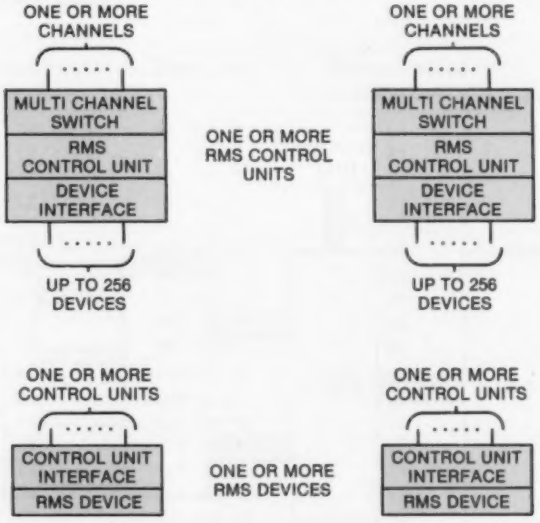


Figure 3—*Maximum subsystem.*



Note: Access to multiple devices, and device sharing, by multiple control units may be done via several techniques not specified by this standard

Figure 4—*RMS subsystem configuration.*

STAFF REPORTS

GAS PHASE STRUCTURE OF SULFURIC ACID

Sulfuric acid is a viscous, highly corrosive liquid at room temperature and is used in almost every chemical laboratory and in many manufacturing processes. It is, in fact, produced in the largest volume of any chemical in the United States. Despite its wide use, its detailed structure has been unknown until now. The structure of the free sulfuric acid molecule was recently determined at NBS from its microwave spectrum.

R. L. Kuczkowski, guest worker from the University of Michigan, R. D. Suenram and F. J. Lovas, Molecular Spectroscopy Division, B268 Physics Building, 301/921-2023.

In recent years sulfuric acid has become of much concern to atmospheric chemists because it is the principal ingredient of "acid rain." A growing interest in spectral studies of gaseous sulfuric acid has resulted. Such studies have been directed primarily at establishing methods for monitoring its presence in emissions from hot smoke stacks.

In spite of their importance, the detailed spectrum and structure of the free molecule in the gas have remained undetermined until now. The primary reason for this is that sulfuric acid is corrosive and difficult to contain, especially at the elevated temperatures required to vaporize it.

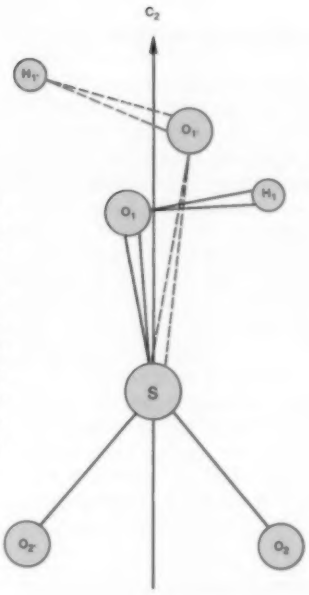


Figure 1—*Structural diagram of free sulfuric acid molecule.*

The microwave spectrum has been observed at NBS with a high sensitivity millimeter wave spectrometer and a specially designed, heated absorption cell that is inert to reactive species at high temperature. For sulfuric acid, the cell temperature was maintained at 100 °C to produce enough sulfuric acid (H_2SO_4) vapor to provide an absorption spectrum. Under these conditions sulfuric acid is somewhat unstable and dissociates to the gaseous products sulfur trioxide (SO_3) and water (H_2O). Thus, continuous pumping of the vapor through the cell was required to minimize decomposition products.

Using data obtained on four different isotopic species ($H_2{}^{32}SO_4$, $H_2{}^{34}SO_4$, $HDSO_4$, D_2SO_4) the molecule has been found to have a structure of C_2 symmetry (Figure 1). In this structure the OH bonds have rotated past the SO_2 and SO_2' bonds, resulting in dihedral angles of 20.8° between the planes. This is rather surprising since most previous work in the literature had considered the OH groups as bisecting the terminal SO_2 group, forming a C_{2v} symmetry species. In addition to the twisting of the OH groups, the two OSO planes are also not precisely perpendicular but deviate from this by 1.6°. Other pertinent structural parameters are given in Table 1.

As a result of this work, it should now be possible to analyze the infrared spectral features yet to be observed with high resolution. Such measurements could lead to much better monitoring devices than are currently available.

Table 1—*Sulfuric Acid Structural Parameters*

Parameters		Values	
Bond Length	Angle	Nanometers	Degrees
OH		0.097 ± 0.001	
SO_1		0.157 ± 0.001	
SO_2		0.142 ± 0.001	
	HOS		108.5 ± 1.5
	O_1SO_1'		101.3 ± 1.0
	O_2SO_2'		123.3 ± 1.0

DIDYMIUM GLASS FILTERS

Certification of two didymium glass filters was recently announced by Kenneth L. Eckerle and William H. Venable, Jr. These two Standard Reference Materials (SRM 2009 and 2010) were made available by the Office of Standard Reference Materials (OSRM).

These SRM's are intended for use in calibrating the wavelength scale in the visible wavelength region of scanning spectrophotometers having nominal bandwidths in the range 1.5 nm to 10.5 nm. Depending upon the bandwidth of the spectrophotometer, from 14 to 24 wavelength corrections can be determined from 400 nm to 760 nm. Detailed instructions on the use of these SRM's and examples of their use are described in NBS Special Publication 260-66. Each didymium-glass filter is identified by the SRM number and a serial number.

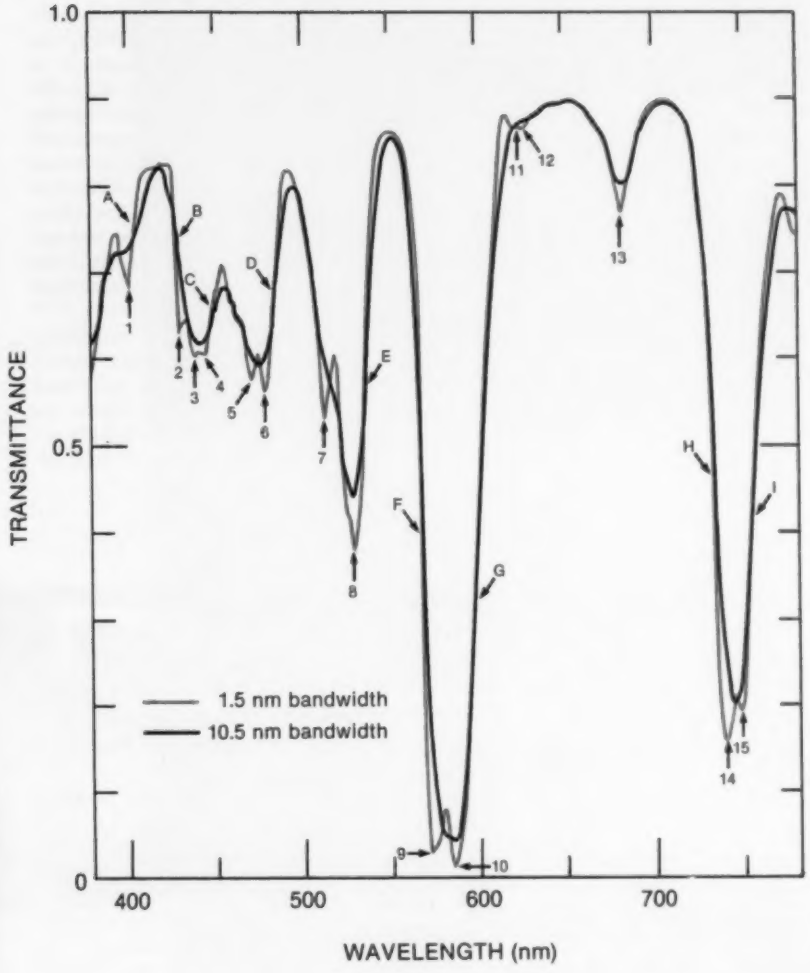
The wavelengths of the transmittance minima, as obtained from measurements on two filters representative of the melt, are given in table 1. These results are given for seven equally spaced values of the half-height width of triangular passbands. The minima are identified in figure 1, which illustrates the spectral transmittance as a function of wavelength. Points of inflection on the spectral transmittance curve, as obtained on two filters, are representative of the melt and also identified in the figure. These inflection points should only be used with the transmittance minima as described in SP 260-66.

The measurements on which the table is based were made at 25 °C with a high-

Table 1—*Certified Wavelengths (nm) of the Transmittance Minima for the Indicated Bandwidths*

Bandwidth Minimum No.	1.5 nm	3.0 nm	4.5 nm	6.0 nm	7.5 nm	9.0 nm	10.5 nm
1	402.42	401.81	401.69	401.66	401.42	400.95	
2	431.50	432.48					
3	440.27	440.52	441.84	442.52	442.37	442.08	441.33
4	445.59	445.14					
5	472.72	472.58	472.88				
6	478.89	479.34	479.28	478.31	477.36	476.50	475.65
7	513.45	513.61	513.89	514.31	515.38		
8	529.58	530.02	529.90	529.47	529.27	529.12	528.88
9	572.69	573.27	574.21	575.11	576.59		
10	585.34	585.54	585.77	586.02	585.99	585.35	584.42
11	623.62	624.02					
12	629.53	629.41	628.56	627.03	627.02		
13	684.66	684.68	684.71	684.72	684.71	684.66	684.58
14	739.86	739.96	740.24	740.91	742.01	742.97	743.65
15	748.28	748.10					

Note: Two additional didymium glass wavelength standards have been added (SRM's 2013 and 2014). These and the two above (SRM's 2009 and 2010) will be accompanied by a special publication, NBS SP 260-66 containing information on their use and an appendix with background material and terminology.



precision reference spectrophotometer with a wavelength accuracy of 0.04 nm. Random and systematic errors of the transmittance minima given in table 1 (as obtained from 4 sets of measurements on a single filter) have also been estimated. Trial calibrations made on several instruments, using both minima and inflection points, indicate that wavelength corrections made with these SRM's can be accurate to 0.2 nm. The uncertainty of a calibration, however, will depend upon the stability and other characteristics of a particular instrument.

The technical and support aspects involved in the preparation, certification, and issuance of SRM's 2009 and 2010 were coordinated through the Office of Standard Reference Materials. Refer certificate inquiries to R. K. Kirby, B316 Chemistry Building, 301/921-2082.

Figure 1—*Spectral transmittance of a typical didymium glass filter. Numbers indicate the principal points of minimum transmittance and letters indicate the principal points of inflection.*

NUMERICAL CONTROL MACHINE TOOLS

The National Bureau of Standards (NBS) and the Air Force Logistics Command (AFLC) have developed guidelines for Automatically Programmed Tools (APT) part programming and postprocessor design that allow a single program written in the APT control language to function without change on a variety of milling and drilling types of numerical control machine tools.

Bradford M. Smith, Center for Mechanical Engineering and Process Technology, A123 Metrology Building, 301/921–2381.

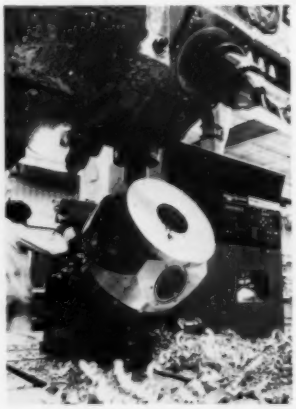
The new guidelines for interchangeable APT data packages were written to conform to the recently revised standard for APT issued by the American National Standards Institute (ANSI). The approach was successfully demonstrated last January at the Sacramento Air Logistics Center when a single APT data package was executed on three different machine tools.

Numerical control machine tools perform their functions automatically in response to programs pre-recorded in some digital form, usually a punched paper tape. In operation, a machinist programmer uses the APT computer language to describe both the geometry of the part to be fashioned and the desired motion of the machine tool. The APT language description, called a part program, is processed first by the APT system and then by a so-called postprocessor which tailors the instructions to the exact requirements of the selected machine tool.

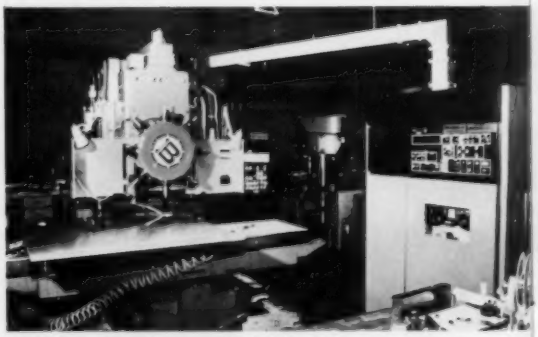
At present the various postprocessors developed by NC machine manufacturers interpret certain APT statements in different and inconsistent ways. As a result, programmers have had to write slightly different APT programs tailored to the idiosyncrasies of each machine. Hence, APT programs are not portable, and a machine will sometimes sit idle while work piles up on another machine because the cost of rewriting the program is prohibitive. The five AFLC production centers presently have 31 machine tools of the milling-drilling type which will benefit from the new approach. A pilot implementation has shown a 23 percent increase in numerical control process efficiency through application of these guidelines.

The NBS/AFLC project developed a rigorous specification for APT postprocessor language that includes a comprehensive definition of the machine functions that result from the use of each APT language statement. The burden is placed upon the postprocessor to insure that these functions are carried out on the machine tool, thus satisfying the intent of the part programmer at all times. If the function cannot be done automatically on a particular NC machine, the postprocessor must simulate the desired operation through alternative means or by human intervention. In this way, the original part program will run on any machine tool where the postprocessor meets this specification. The concept produces savings in labor, leadtime, and the cost of part programming, and allows jobs to be shifted quickly from one machine to another without expensive reprogramming, giving shops greater flexibility in their work schedules.

NBS has provided the AFLC with a programmer user's manual, software specifications for use in procuring new postprocessors, and a software guide to aid in reprogramming existing postprocessors. Copies of these documents are available from the Center for Mechanical Engineering and Process Technology, National Bureau of Standards, Washington, DC 20234.



Left. Typical machining job.



Right. A numerically controlled mill.

CONFERENCES

For general information on NBS conferences, contact JoAnn Lorden, NBS Public Information Division, Washington, DC 20234, 301/921-2721.

The Second International Conference on the Durability of Building Materials and Components will be held at the National Bureau of Standards in Gaithersburg, Md., September 14-16, 1981.

The conference is sponsored by NBS, the American Society for Testing and Materials, the International Council for Building Research Studies and Documentation (CIB), the National Research Council of Canada, and the International Union of Materials and Structures Testing and Research Laboratories (RILEM).

Intended to improve knowledge about the prediction of the life cycle or service life (durability) of non-metallic building materials and components, the conference will bring together scientists, engineers, architects, economists, and others concerned with the subject. This includes those studying the environmental factors which affect service life and those primarily concerned with evaluating life-cycle costs. The conference will deal with the subject matter in sufficient depth to serve the researcher while retaining enough of a practical orientation to be useful to the practitioner.

The conference will cover:

- Durability performance of non-metallic building materials of all generic types—inorganic, organic (including wood-based materials), and composites
- Effects of environmental factors on durability performance
- Degradation processes of building materials and components
- Prediction of service life from knowledge of degradation processes
- Methodologies and test methods for service life prediction, and
- Economic aspects of durability performance of building materials, including life-cycle cost-benefit analyses.

For further information, contact: Dr. Geoffrey Frohnsdorff, B348 Building Research Building, NBS, 301/921-3458.

CONFERENCE CALENDAR

October 7-9
COAL CONVERSION, NBS, Gaithersburg, MD; sponsored by NBS and DOE; contact: Samuel Schneider, B308 Materials Building, 301/921-2894.

***October 16-17**
INTERNATIONAL MACHINE TOOL TASK FORCE CONFERENCE, McCormick Inn, Chicago, Illinois; sponsored by USAF Wright Aeronautical Laboratories with the cooperation of NBS; contact: Robert Hocken, B104 Metrology Building, 301/921-2216.

October 20-21
INTERNATIONAL COUNCIL FOR BUILDING RESEARCH, STUDIES, AND DOCUMENTATION, NBS, Gaithersburg, MD; sponsored by NBS and NSF; contact: Preston McNall, B114 Building Research Building, 301/921-3637.

October 22-24
FOURTH ANNUAL CONFERENCE ON FIRE RESEARCH, NBS, Gaithersburg, MD; sponsored by NBS; contact: Sonya Cherry, B258 Polymers Building, 301/921-3845.

October 23
WORKSHOP ON REFERENCE MATERIALS FOR ORGANIC NUTRIENT MEASUREMENT, NBS, Gaithersburg, MD; sponsored by NBS; contact: Dr. Sam Margolis, A367 Chemistry Building, 301/921-2867.

***November 18-20**
THIRD SEMINAR ON THE DEPARTMENT OF DEFENSE COMPUTER SECURITY INITIATIVE PROGRAM, NBS, Gaithersburg, MD; sponsored by NBS and DOD; contact: Dennis K. Branstad, A255 Technology Building, 301/921-3861.

December 10
COMPUTER NETWORKING SYMPOSIUM, NBS, Gaithersburg, MD; sponsored by NBS and IEEE; contact: Robert Toense, B226 Technology Building, 301/921-3516.

1981

March 17-18
SECOND CONFERENCE ON CONSUMER PRODUCT STANDARDS, NBS, Gaithersburg, MD; sponsored by NBS and ASTM; contact: Walter Leight, 111 EM Building, 301/921-3750.

April 6-10
6TH INTERNATIONAL SYMPOSIUM ON NOISE IN PHYSICAL SYSTEMS, NBS, Gaithersburg, MD; sponsored by NBS and the Catholic University of America; contact: Robert J. Soulen, B128 Physics Building, 301/921-2018.

April 30-May 1
NATIONAL ROOFING TECHNOLOGY CONFERENCE, NBS, Gaithersburg, MD; sponsored by NBS and NCRA; contact: Robert Mathey, B348 Building Research Building, 301/921-2629.

***June 1-3**
6th INTERNATIONAL SYMPOSIUM ON IMAGING AND ULTRASONIC TISSUE CHARACTERISTICS, NBS, Gaithersburg, MD; sponsored by NBS, NIH, IEEE, and AIUM; contact: Mel Linzer, A366 Materials Building, 301/921-2611.

June 8-12
SECOND INTERNATIONAL CONFERENCE ON PRECISION MEASUREMENTS AND FUNDAMENTAL CONSTANTS, NBS, Gaithersburg, MD; sponsored by NBS, IUPAP, and AMCO; contact: Barry N. Taylor, B258 Metrology Building, 301/921-2701.

June 15-19
INTERNATIONAL JOINT CONFERENCE ON THERMOPHYSICAL PROPERTIES, NBS, Gaithersburg, MD; sponsored by NBS, ASME, and Purdue University; contact: A. Cezairliyan, Room 124 Hazards Building, 301/921-3687.

*New Listings

PUBLICATIONS

COST EFFECTIVENESS OF PASSIVE SOLAR HEATING

*An Economic Model for Passive Solar Designs in Commercial Environments, Powell, J. W., Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 125, 146 pages (June 1980) Stock No. 003-003-02203-9, $4.75.**

A method for evaluating the cost effectiveness of passive solar designs for commercial buildings has been developed by the National Bureau of Standards. The method, which was developed by the NBS Center for Building Technology with Department of Energy funding, provides a new analytical tool for the building community, policy makers, financiers, and investors. The model provides a comprehensive assessment of an investment in passive solar energy for commercial buildings. It is illustrated with two case studies of representative passive solar energy systems designed for an urban renewal neighborhood of Baltimore, Md. One was a wall, air-collector system for a three story, semi-detached building; the second was a glazed canopy for enclosing the street and pedestrian areas among 48 buildings. The analysis indicates these designs may be economically feasible under a realistic range of economic conditions.

The method incorporates a cost-benefit analysis approach that includes such variables as costs of purchase, installation, maintenance, repairs, replacements, and energy use. It considers a number of potential economic benefits such as higher rental income from commercial space, lower electric lighting costs due to daylighting, reduced heating costs, and higher property values and extended property lives. A detailed analysis of tax laws and incentives affecting the use of solar energy in commercial buildings is also provided. This type of analysis is especially useful for evaluating solar and other energy conservation projects because a large portion of the costs occurs with the initial investment, while the benefits accrue over the entire life of the project.

Passive solar energy systems collect and transport heat primarily by non-mechanical means and usually are integral elements of a building structure. Typical features may include south-facing glass or transparent plastic for solar collection and thermal mass for heat absorption, storage, and distribution. Passive systems can be included in new building designs, added to existing buildings, or designed to function outside of, but in conjunction with, a group of new or existing buildings.

Most experience with and study of passive solar energy economics have related to the residential sector; different assumptions and data are required to evaluate commercial applications. Furthermore, the literature on the more popular "active" systems—those that use mechanical processes for solar energy collection and distribution—offers little assistance in studying the economics of passive systems.

The author of the report, economist Jeanne W. Powell, suggests further areas of research for passive solar systems, including the measurement of acoustical, aesthetic, comfort, and health effects.

BUILDING CODES DO NOT IMPEDE SOLAR PROJECTS

Greenberg, J., Analysis of Code Related Responses from the Solar Demonstration Program, Nat. Bur. Stand. (U.S.), NBSIR 79-1957, 153 pages (Jan. 1980). Available from National Technical Information Service, Springfield, VA 22161, for $11.

Existing building codes do not present barriers to the installation and acceptance of solar heating and cooling systems, according to a report from the Department of Commerce's National Bureau of Standards. NBS has also concluded that code officials need additional training and better back-up material in order to evaluate systems and properly inspect the installations.

The NBS report contains data and information gathered from builders and building code officials who had been involved with projects sponsored by the Department of Housing and Urban Development (HUD) and the Department of Energy (DOE) during a 3-year period of their ongoing Solar Residential Demonstration Program. This program was established in 1974 by HUD and DOE to promote solar use across the country. To determine if building code officials had a tendency to reject solar projects because of building codes that did not adequately address solar designs, HUD and DOE asked NBS to review the responses of builders and building code officials. Their reactions and the NBS analysis are included in *Analysis of Code Related Responses from the Solar Demonstration Program*, a report issued recently by the Bureau.

Eighty percent of local building code officials indicated that there are no major barriers in building codes at present which would impede the installation of solar energy systems in their jurisdictions. Furthermore, solar builders reported that they face no greater or lesser difficulty in getting their projects approved by building officials than that routinely faced by non-solar builders.

The report concludes that building code officials are concerned with toxic fluids used in solar systems, the adequacy of older structures to support the added solar components, and the inherent complexity associated with installing solar systems in large, multi-family buildings.

The NBS study also indicates that code officials would be better prepared to evaluate solar installations if they knew more about the different solar energy systems on the market. Code officials reported that programs which trained

* *Publications cited here may be purchased at the listed price from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (foreign: add 25%). Microfiche copies are available from the National Technical Information Service, Springfield, VA 22161. For complete periodic listings of all scientific papers and articles produced by NBS staff, write: Editor, Publications Newsletter, Administration Building, National Bureau of Standards, Washington, D.C. 20234.*

evaluators and inspectors, developed manuals of accepted practice, and certified solar equipment would be beneficial.

The *Analysis of Code Related Responses from the Solar Demonstration Program* (NBSIR 79-1957) is the latest publication that is the result of DOE and HUD's Solar Residential Demonstration Program. Since the program's inception in 1974, NBS had provided technical monitoring of the design, testing and evaluation, construction, and operational phases of the demonstration program. Findings from this recent study should aid HUD and DOE, as well as volunteer standards writing committees, building code organizations, and the building community in general, to promote solar use by helping them address underlying barriers to widespread adoption of solar technologies.

1979 NBS LITERATURE CATALOG

Burris, B., and Morehouse, R. J., Eds., Publications of the National Bureau of Standards 1979 Catalog, Nat. Bur. Stand. (U.S.), Spec. Publ. 305 Suppl. 11, 615 pages (Feb. 1980) Stock No. 003-003-02194-6, $11.

Some 1000 papers concerning the research and technical services of the National Bureau of Standards are described and annotated in the Bureau's latest annual catalog, *Publications of the National Bureau of Standards* SP 305/Supplement 11.

The new volume is the third annual supplement issued since publication of an 11-year consolidated catalog covering 1966 through 1976. Included are listings of all 1979 publications with their abstracts and those of some earlier papers omitted from Supplement 10. Also included are key word and author indexes and general information and instructions about procedures for ordering NBS publications.

PUBLICATIONS LISTING

Analytical Chemistry

Fatiadi, A. J., Pseudo-Oxcarbons. Synthesis of 2,1,3-bis and 1,2,3-tris (dicyanomethylene) Croconate Salts. New Bond-Delocalized Dianions, "Croconate Violet" and "Croconate Blue," J. Res. Nat. Bur. Stand. 85, No. 2, 73-86 (Mar.-Apr. 1980).

Heinrich, K. F. J., Ed., Characterization of Particles. Proceedings of the Particle Analysis Session of the 13th Annual Conference of the Microbeam Analysis Society held at Ann Arbor, MI, June 22, 1978, Nat. Bur. Stand. (U.S.), Spec. Publ. 533, 222 pages (Apr. 1980) Stock No. 003-003-02175-0, $6.50.

Health and Safety

Collé, R., and McCall, P. E., Jr., Eds., Radon in Buildings. Proceedings of a Roundtable Discussion of Radon in Buildings, held at the National Bureau of Standards, Gaithersburg, MD, June 15, 1979, Nat. Bur. Stand. (U.S.), Spec. Publ. 581, 84 pages (June 1980) Stock No. 003-003-02196-2, $3.75.

Yokel, F. Y., Recommended Technical Provisions for Construction Practice in Shoring and Sloping of Trenches and Excavations, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 127, 84 pages (June 1980) Stock No. 003-003-02195-4, $3.75.

Electronic Technology

Bullis, W. M., Semiconductor Measurement Technology: Metrology for Submicrometer Devices and Circuits, Nat. Bur. Stand. (U.S.), Spec. Publ. 400-61, 41 pages (June 1980) Stock No. 003-003-02198-9, $2.25.

Perrey, A. G., and Schoenwetter, A Schottky Diode Bridge Sampling Gate, Nat. Bur. Stand. (U.S.), Tech. Note 1121, 18 pages (May 1980) Stock No. 003-003-02197-1, $1.50.

Wollin, H. F., Barbrow, L. E., and Hefferan. A. P., Eds., Report of the 64th National Conference on Weights and Measures 1979, Nat. Bur. Stand. (U.S.), Spec. Publ. 566, 313 pages (Mar. 1980) Stock No. 003-003-02147-4, $7.

Energy Conservation and Production

Burr, W. E., Clark, G., Little, J., and Pyke, T., Operational Specifications for Rotating Mass Storage Subsystem, Nat. Bur. Stand. (U.S.), Fed. Info. Process. Stand. Publ. (FIPS PUB) 63, 86 pages (1980).

Knab, L. I., Jenkins, D. R., and Mathey, R. G., The Effect of Moisture on the Thermal Conductance of Roofing Systems, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 123, 46 pages (Apr. 1980) Stock No. 003-003-02168-7, $3.50.

Powell, J. W., An Economic Model for Passive Solar Designs in Commercial Environments, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 125, 146 pages (June 1980) Stock No. 003-003-02203-9, $4.75.

Engineering, Product, and Information Standards

Ellingwood, B., Galambos, T. V., MacGregor, J. G., and Cornell, C. A., Eds. Development of a Probability Based Load Criterion for American National Standard A58—Building Code Requirements for Minimum Design Loads in Buildings and Other Structures, Nat. Bur. Stand. (U.S.), Spec. Publ. 577, 228 pages (June 1980) Stock No. 003-003-02200-4, $6.

Phucas, C. B., Ed., Symposium on International Standards Information and ISONET. Proceedings of a Symposium held at the National Bureau of Standards, Gaithersburg, MD, Oct. 11-12, 1979, Nat. Bur. Stand. (U.S.), Spec. Publ. 579, 61 pages (June 1980) Stock No. 003-003-02202-1, $3.50.

General Theoretical Chemistry and Physics

Munro, R. G., Radial Distribution Studies Under Highly Constrained Conditions, J. Res. Nat. Bur. Stand. (U.S.), 85, No. 2, 99-108 (Mar.-Apr. 1980).

Properties of Materials: Structural and Mechanical

Himes, V. L., Mighell, A. D., Hubbard, C. R., and Fatiadi, A. J., New Bond-Delocalized Dianions: The Crystal Structure of 1,3-bis (Dicyanomethylene) Croconate Salt ($C_8N_4O_2K_2 \cdot 2H_2O$), J. Res. Nat. Bur. Stand. (U.S.), 85, No. 2, 87-97 (Mar.-Apr. 1980).

Mountain, R. D., and Knauss, D. C., High Temperature Elastic Constants and the Evaluation of Effective Pair Potentials, J. Res. Nat. Bur. Stand. (U.S.), 85, No. 2, 109-112 (Mar.-Apr. 1980).

Stalick, J. K., Mighell, A. D., and Boreni, R. J., User Evaluation of Crystal Data Products and Services: Questionnaire Analysis and Impact, Nat. Bur. Stand. (U.S.), Tech. Note 1112, 42 pages (June 1980) Stock No. 003-003-02201-2, $2.25.

Waterstrat, R. M., Systematic Relationships Among Binary Phase Diagrams of the Transition Elements, Nat. Bur. Stand. (U.S.), Spec. Publ. 564, (May 1980) Stock No. 003-003-02193-8, $2.

Standard Reference Data

Baulch, D. L., Cox, R. A., Hampson, R. F., Jr., Kerr, J. A., Troe, J., and Watson, R. T., Evaluated Kinetic and Photochemical Data for Atmospheric Chemistry, J. Phys. Chem. Ref. Data 9, No. 2, 295-472 (1980).

Moore, C. E., Selected Tables of Atomic Spectra, Nat. Bur. Stand. Ref. Data Ser., Nat. Bur. Stand. (U.S.), 3, Sec. 9, 21 pages (May 1980) Stock No. 003-003-02134-2, $2.75.

Sugar, J., and Corliss, C., Energy Levels of Scandium, Sc I through Sc XXI, J. Phys. Chem. Ref. Data 9, No. 2, 472-512 (1980).

Wu, Y. C., and Hamer, W. J., Revised Values of the Osmotic Coefficients and Mean Activity Coefficients of Sodium Nitrate in Water at 25 °C, J. Phys. Chem. Ref. Data 9, No. 2, 513-518 (1980).

NEWS BRIEFS

NBS, PBS, ABC HONORED FOR CLOSED TV CAPTIONING. NBS, together with the Public Broadcasting Service (PBS) and the American Broadcasting Company (ABC), were awarded an Emmy by the Academy of Television Arts & Sciences for outstanding achievement in engineering development for the invention and development of closed TV captioning for the deaf. Closed captioning had its roots in a system called "TvTime" developed by NBS engineers in 1971 as a way to broadcast time and frequency information on television channels without disturbing regular shows. The system became a reality for American viewers when regular broadcasts of selected programming began last March.

LIQUID CHROMATOGRAPH/MASS SPECTROMETER INTERFACE. A patent has been awarded to NBS scientists for a liquid chromatograph/mass spectrometer interface (LC/MS). Essentially the entire sample flows from a conventional liquid chromatograph, is introduced into a differentially pumped quadrupole mass spectrometer, and yields both electron impact and chemical ionization spectra. The direct link between the liquid chromatograph and mass spectrometer permits analysis of relatively non-volatile compounds in complex mixtures (e.g., shale oil) without the extensive sample handling required in the past.

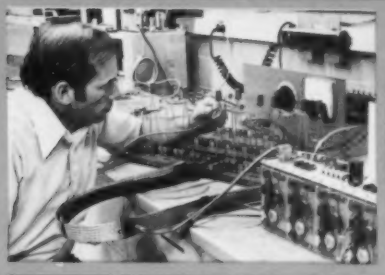
VOTING SYSTEM STUDY. Public Law 96-187 (Jan. 8, 1980) establishes that the "Federal Election Commission, with the cooperation and assistance of NBS shall conduct a preliminary study with respect to the future development of voluntary engineering and procedural performance standards for voting systems used in the United States." The study, to begin in FY 1981, will plan for the subsequent development of specific voting system standards. This study follows an earlier ICST report, The Effective Use of Computing Technology in Vote Tallying (NBS Spec. Pub. 500-30), which has been widely disseminated throughout the election community.

NEW CALIBRATION SERVICE OFFERED. The Center for Mechanical Engineering and Process Technology's Fluid Engineering Division now provides a new calibration service for the dynamic response of mechanical rotary anemometers. This service consists of providing the "distant constant" characterizing the dynamic response as well as the degree of "over-registration" associated with nonlinear behavior of the instrument. The calibration is carried out in the NBS unsteady flow wind tunnel in which the air flow can be oscillated in the frequency range from 0.1 Hz to 25 Hz.

SEMICONDUCTOR PROGRAM BRIEFS. Fifteen Federal agencies and laboratories sponsor research at NBS on measurement problems connected with semiconductor technology. Current results, work in progress, and available publications are reviewed quarterly in an informal newsletter, the Semiconductor Technology Program Progress Briefs. Copies and subscription information are available to interested persons in the semiconductor field from Electron Devices Division, NBS, Washington, DC 20234, Telephone: 301/921-3786.

NEXT MONTH IN

DIMENSIONS/NBS



Electrical wiring—every home has it yet little scientific data has been gathered on its safety and performance. Read about NBS efforts to understand more about electrical wiring systems in the October issue of DIMENSIONS/NBS.

U.S. DEPARTMENT OF COMMERCE
Philip M. Klutznick, Secretary
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